B.E. (Agriculture Engineering) Revised 2018

Regulations, Curriculum & Syllabi

(Candidates admitted during Academic Year 2021-2022)

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University – Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

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CONTENTS

VISION OF THE DEPARTMENT

- To develop Agricultural Engineers with wealth of knowledge in Agriculture to meet the global demand and serving society to reach sustainable food and nutritional security.

MISSION OF THE DEPARTMENT

- To ensure effective teaching learning process by imparting theoretical and practical knowledge on conventional and modern technology based agricultural systems.
- To provide amicable environment for students to develop innovative technologies for agriculture and allied sectors.
- To develop agricultural engineering graduates skillful to blossom into entrepreneurs, scientists, academicians and technocrats for sustainable food production.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Graduates of the B.E. Agricultural Engineering will be able to

1. Excel in academic/professional career by acquiring knowledge and skill in engineering principles involved in Agriculture
2. Analyze and improve agricultural operations through farm mechanization, land and water management, post-harvest handling and energy conservation to increase yield and land use efficiency
3. Develop professionalism in management, entrepreneurship, continuous learning and follow ethics to serve the society

PROGRAMME OUTCOMES (POs)

The students will possess

a. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. **Problem Analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. **Design/ Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

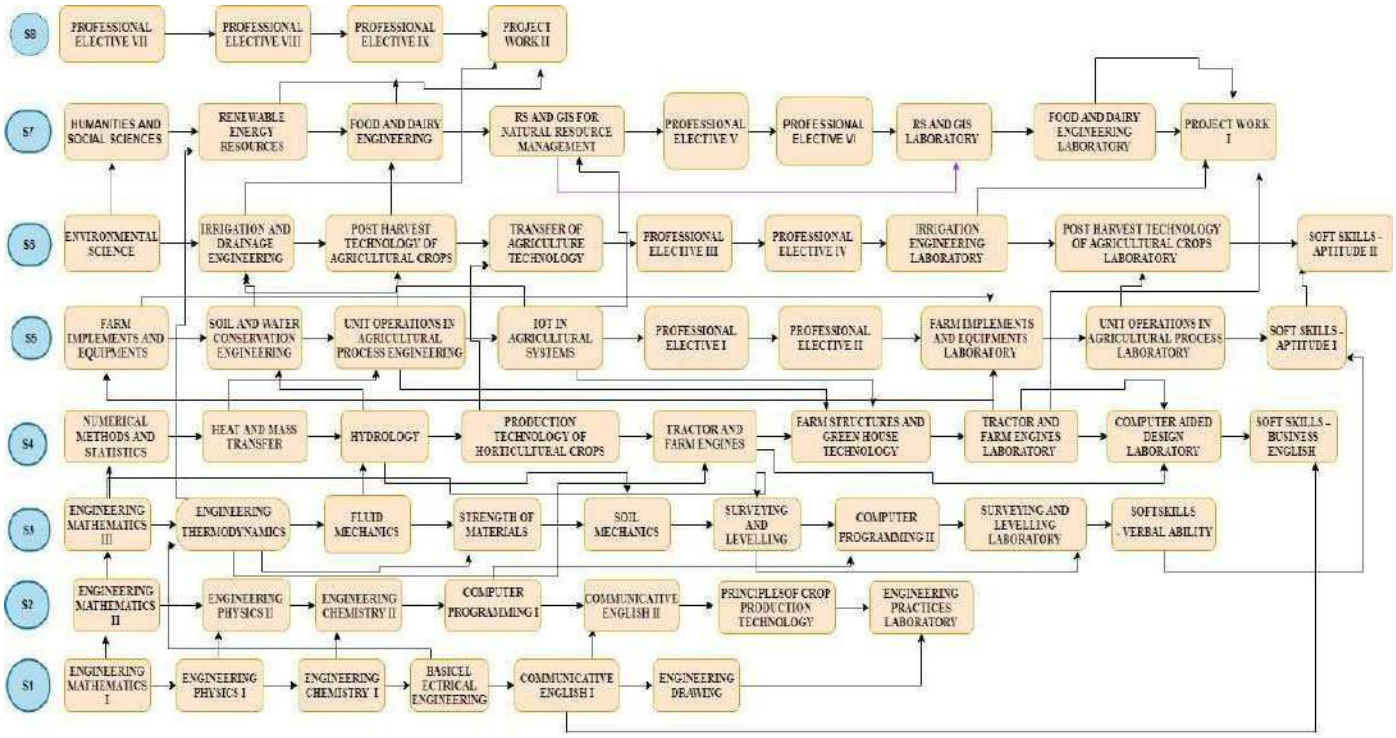
l. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OBJECTIVE(S)

1. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
2. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

MAPPING WITH PEOS AND POS

POs	a	b	c	d	e	f	g	h	i	j	k	l
PEO I	X		X	X	X				X			
PEO II		X	X	X	X			X				X
PEO III						X	X	X	X	X		


S8
PROFESSIONAL ELECTIVE VII
PROFESSIONAL ELECTIVE VIII
PROFESSIONAL ELECTIVE IX
PROJECT WORK II
S7
HUMANITIES AND SOCIAL SCIENCES
RENEWABLE ENERGY RESOURCES
FOOD AND DAIRY ENGINEERING
RS AND GIS FOR NATURAL RESOURCE MANAGEMENT
PROFESSIONAL ELECTIVE V
PROFESSIONAL ELECTIVE VI
RS AND GIS LABORATORY
FOOD AND DAIRY ENGINEERING LABORATORY
PROJECT WORK I
S6
ENVIRONMENTAL SCIENCE
IRRIGATION AND DRAINAGE ENGINEERING
POST HARVEST TECHNOLOGY OF AGRICULTURAL CROPS
TRANSFER OF AGRICULTURE TECHNOLOGY
PROFESSIONAL ELECTIVE III
PROFESSIONAL ELECTIVE IV
IRRIGATION ENGINEERING LABORATORY
POST HARVEST TECHNOLOGY OF AGRICULTURAL CROPS LABORATORY
SOFT SKILLS - APTITUDE II
S5
FARM IMPLEMENTS AND EQUIPMENTS
SOIL AND WATER CONSERVATION ENGINEERING
UNIT OPERATIONS IN AGRICULTURAL PROCESS ENGINEERING
IOT IN AGRICULTURAL SYSTEMS
PROFESSIONAL ELECTIVE I
PROFESSIONAL ELECTIVE II
FARM IMPLEMENTS AND EQUIPMENTS LABORATORY
UNIT OPERATIONS IN AGRICULTURAL PROCESS LABORATORY
SOFT SKILLS - APTITUDE I
S4
NUMERICAL METHODS AND STATISTICS
HEAT AND MASS TRANSFER
HYDROLOGY
PRODUCTION TECHNOLOGY OF HORTICULTURAL CROPS
TRACTOR AND FARM ENGINES
FARM STRUCTURES AND GREEN HOUSE TECHNOLOGY
TRACTOR AND FARM ENGINES LABORATORY
COMPUTER AIDED DESIGN LABORATORY
SOFT SKILLS - BUSINESS ENGLISH
S3
ENGINEERING MATHEMATICS III
ENGINEERING THERMODYNAMICS
FLUID MECHANICS
STRENGTH OF MATERIALS
SOIL MECHANICS
SURVEYING AND LEVELLING
COMPUTER PROGRAMMING II
SURVEYING AND LEVELLING LABORATORY
SOFTSKILLS - VERBAL ABILITY
S2
ENGINEERING MATHEMATICS II
ENGINEERING PHYSICS II
ENGINEERING CHEMISTRY II
COMPUTER PROGRAMMING I
COMMUNICATIVE ENGLISH II
PRINCIPLES OF CROP PRODUCTION TECHNOLOGY
ENGINEERING PRACTICES LABORATORY
S1
ENGINEERING MATHEMATICS I
ENGINEERING PHYSICS I
ENGINEERING CHEMISTRY I
BASICEL ECTRICAL ENGINEERING
COMMUNICATIVE ENGLISH I
ENGINEERING DRAWING

B.E. AGRICULTURE ENGINEERING
Minimum Credits to be Earned: 163

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18AG101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
18AG102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
18AG103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18AG104	BASIC ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HSS
18AG105	ENGINEERING DRAWING	1	0	4	3	5	100	0	100	ES
Total		**11**	**1**	**12**	**18**	**24**	-	-	-	-

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18AG201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
18AG202	ENGINEERING PHYSICS II	2	0	2	3	4	50	50	100	BS
18AG203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18AG204	COMPUTER PROGRAMMING I	2	0	2	3	4	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
18AG205	PRINCIPLES OF CROP PRODUCTION TECHNOLOGY	2	0	2	3	4	50	50	100	PC
18AG206	ENGINEERING PRACTICES LABORATORY	0	0	4	2	4	100	0	100	ES
Total		**12**	**1**	**14**	**20**	**27**	-	-	-	-

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18GE301	ENGINEERING MATHEMATICS III	3	1	0	4	4	40	60	100	BS
18AG302	ENGINEERING THERMODYNAMICS	3	0	0	3	3	40	60	100	ES
18AG303	FLUID MECHANICS	3	0	2	4	5	50	50	100	ES
18AG304	STRENGTH OF MATERIALS	3	1	0	4	4	40	60	100	ES
18AG305	SOIL MECHANICS	3	0	2	4	5	50	50	100	PC
18AG306	SURVEYING AND LEVELING	3	0	0	3	3	40	60	100	PC
18AG307	COMPUTER PROGRAMMING II	1	0	4	3	5	50	50	100	ES
18AG308	SURVEYING AND LEVELLING LABORATORY	0	0	2	1	2	100	0	100	PC
18GE301	SOFT SKILLS - VERBAL ABILITY	0	0	2	-	2	100	0	100	EEC
Total		**19**	**2**	**12**	**26**	**33**	-	-	-	-
IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18AG401	NUMERICAL METHODS AND STATISTICS	3	1	0	4	4	40	60	100	ES
18AG402	HEAT AND MASS TRANSFER	3	0	2	4	5	50	50	100	PC
18AG403	HYDROLOGY	3	1	0	4	4	40	60	100	PC
18AG404	PRODUCTION TECHNOLOGY OF HORTICULTURAL CROPS	2	0	2	3	4	50	50	100	PC
18AG405	TRACTOR AND FARM ENGINES	3	0	0	3	3	40	60	100	PC
18AG406	FARM STRUCTURES AND GREEN HOUSE TECHNOLOGY	3	1	0	4	4	40	60	100	PC
18AG407	TRACTOR AND FARM ENGINES LABORATORY	0	0	4	2	4	100	0	100	PC
18AG408	COMPUTER AIDED DESIGN LABORATORY	0	0	4	2	4	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
18GE401	SOFT SKILLS – BUSINESS ENGLISH	0	0	2	-	2	100	0	100	EEC
Total		**19**	**3**	**14**	**26**	**36**	**-**	**-**	**-**	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21AG501	FARM IMPLEMENTS AND EQUIPMENT	3	0	0	3	3	40	60	100	PC
21AG502	SOIL AND WATER CONSERVATION ENGINEERING	3	1	0	4	4	40	60	100	PC
21AG503	UNIT OPERATIONS IN AGRICULTURAL PROCESS	3	0	0	3	3	40	60	100	PC
21AG504	IOT IN AGRICULTURAL SYSTEMS	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	40	60	100	PE
21AG507	FARM IMPLEMENTS AND EQUIPMENT LABORATORY	0	0	2	1	2	100	0	100	PC
21AG508	UNIT OPERATIONS IN AGRICULTURAL PROCESS ENGINEERING LABORATORY	0	0	2	1	2	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	-	2	100	0	100	EEC
Total		**18**	**1**	**8**	**22**	**27**	-	-	-	-
VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21HS002	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HSS
21AG602	IRRIGATION AND DRAINAGE ENGINEERING	3	0	0	3	3	40	60	100	PC
21AG603	POST HARVEST TECHNOLOGY OF AGRICULTURAL CROPS	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE III	-	-	-	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IV	-	-	-	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE V	-	-	-	3	3	40	60	100	PE
21AG607	IRRIGATION ENGINEERING LABORATORY	0	0	2	1	2	100	0	100	PC
21AG608	POST HARVEST TECHNOLOGY OF AGRICULTURAL CROPS	0	0	2	1	2	100	0	100	PC
18GE601	SOFT SKILLS-APTITUDE II	0	0	2	-	2	100	0	100	EEC
Total		**8**	**0**	**6**	**19**	**25**	-	-	-	-

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21AG701	RS AND GIS FOR NATURAL RESOURCE MANAGEMENT	3	0	2	4	5	50	50	100	PC
21AG702	RENEWABLE ENERGY RESOURCES	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE VI	-	-	-	3	3	40	60	100	PE
	PROFESSIONAL ELECYIVE VII	-	-	-	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VIII	-	-	-	3	3	40	60	100	PE
	PROFESSIONAL ELECYIVE IX	-	-	-	3	3	40	60	100	PE
21AG707	PROJECT WORK I	0	0	6	3	6	60	40	100	EEC
Total		**6**	**0**	**10**	**23**	**28**	-	-	-	-
VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21AG801	PROJECT WORK II	0	0	18	9	18	60	40	100	EEC
Total		**0**	**0**	**18**	**9**	**18**	**50**	**50**	**100**	-

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
DISCIPLINE ELECTIVES VERTICAL I- FARM MACHINERY										
21AG001	HUMAN ENGINEERING AND SAFETY	3	0	0	3	3	40	60	100	PE
21AG002	DESIGN OF AGRICULTURAL MACHINERY	3	0	0	3	3	40	60	100	PE
21AG003	TESTING AND EVALUATION OF FARM MACHINERY AND EQUIPMENT	3	0	0	3	3	40	60	100	PE
21AG004	FARM POWER AND MACHINERY MANAGEMENT	3	0	0	3	3	40	60	100	PE
21AG005	HYDRAULIC DRIVES AND CONTROLS	3	0	0	3	3	40	60	100	PE
21AG006	PRECISION FARMING EQUIPMENT	3	0	0	3	3	40	60	100	PE
VERTICAL II- SOIL AND WATER CONSERVATION ENGINEERING										
21AG007	BUILDING MATERIALS, ESTIMATION AND COSTING	3	0	0	3	3	40	60	100	PE
21AG008	GROUNDWATER, WELLS AND PUMPS	3	0	0	3	3	40	60	100	PE
21AG009	PROTECTED CULTIVATION	3	0	0	3	3	40	60	100	PE
21AG010	DESIGN OF MICRO-IRRIGATION SYSTEMS	3	0	0	3	3	40	60	100	PE
21AG011	WATERSHED PLANNING AND MANAGEMENT	3	0	0	3	3	40	60	100	PE
21AG012	RESERVOIR AND FARM POND DESIGN	3	0	0	3	3	40	60	100	PE
21AG045	WATER HARVESTING TECHNIQUES	3	0	0	3	3	40	60	100	PE

VERTICAL III- AGRICULTURAL PROCESSING										
21AG013	REFRIGERATION AND COLD STORAGE	3	0	0	3	3	40	60	100	PE
21AG014	FRUITS AND VEGETABLES PROCESSING	3	0	0	3	3	40	60	100	PE
21AG015	FOOD AND DAIRY ENGINEERING	3	0	0	3	3	40	60	100	PE
21AG016	FOOD SAFETY MANAGEMENT SYSTEMS	3	0	0	3	3	40	60	100	PE
21AG017	EMERGING TECHNOLOGIES IN FOOD PROCESS ENGINEERING	3	0	0	3	3	40	60	100	PE
21AG018	FOOD PROCESS EQUIPMENT AND DESIGN	3	0	0	3	3	40	60	100	PE
VERTICAL IV- RENEWABLE ENERGY ENGINEERING										
21AG019	BIO AND THERMO CHEMICAL CONVERSION OF BIOMASS	3	0	0	3	3	40	60	100	PE
21AG020	SOLAR AND WIND ENGINEERING	3	0	0	3	3	40	60	100	PE
21AG021	ENERGY CONSERVATION IN AGRO-BASED INDUSTRY	3	0	0	3	3	40	60	100	PE
21AG022	CO - GENERATION AND WASTE HEAT RECOVERY SYSTEMS	3	0	0	3	3	40	60	100	PE
21AG023	GREEN BUILDINGS	3	0	0	3	3	40	60	100	PE
21AG024	ENERGY STORAGE SYSTEMS	3	0	0	3	3	40	60	100	PE
21AG025	CDM AND CARBON TRADING TECHNOLOGY	3	0	0	3	3	40	60	100	PE
VERTICAL V- CROP PRODUCTION & PROTECTION										
21AG026	SOIL FERTILITY AND NUTRIENT MANAGEMENT	3	0	0	3	3	40	60	100	PE
21AG027	PLANT PROTECTION	3	0	0	3	3	40	60	100	PE
21AG028	EXTENSION METHODOLOGY AND TRANSFER OF TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21AG029	AGRICULTURAL MARKETING	3	0	0	3	3	40	60	100	PE
21AG030	INTEGRATED FARMING SYSTEM	3	0	0	3	3	40	60	100	PE
21AG031	SUSTAINABLE AGRICULTURE AND FOOD SECURITY	3	0	0	3	3	40	60	100	PE

VERTICAL VI- SMART AGRICULTURE SYSTEMS										
21AG032	INSTRUMENTATION AND CONTROL ENGINEERING IN AGRICULTURE	3	0	0	3	3	40	60	100	PE
21AG033	DATABASE MANAGEMENT AND MICROPROCESSOR APPLICATIONS IN AGRICULTURE	3	0	0	3	3	40	60	100	PE
21AG034	DATA ANALYTICS IN AGRICULTURAL SYSTEMS	3	0	0	3	3	40	60	100	PE
21AG035	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FOR AGRICULTURE	3	0	0	3	3	40	60	100	PE
21AG036	MECHATRONICS IN AGRICULTURAL ENGINEERING	3	0	0	3	3	40	60	100	PE
21AG037	GEOINFORMATICS AND NANO TECHNOLOGY	3	0	0	3	3	40	60	100	PE
VERTICAL VII- AGRI BUSINESS AND ENTREPRENEURSHIP										
21AG038	AGRI BUSINESS MANAGEMENT AND ENTREPRENEURSHIP	3	0	0	3	3	40	60	100	PE
21AG039	AGRICULTURAL FINANCE, BANKING AND CO-OPERATION	3	0	0	3	3	40	60	100	PE
21AG040	TECHNOLOGY OF SEED PROCESSING	3	0	0	3	3	40	60	100	PE
21AG041	MUSHROOM CULTIVATION & VERMICOMPOSTING	3	0	0	3	3	40	60	100	PE
21AG042	ENGINEERING ECONOMY AND PROJECT PLANNING	3	0	0	3	3	40	60	100	PE
21AG043	VALUE ADDITION OF INDIGENOUS FRUITS AND VEGETABLES	3	0	0	3	3	40	60	100	PE
21AG044	PRINCIPLES OF ORGANIC FARMING	3	0	0	3	3	40	60	100	PE
ONE CREDIT COURSES										
18AG0XA	OPERATION AND MAINTENANCE OF MICRO IRRIGATION SYSTEM	0	0	0	1		100	0	100	EEC
18AG0XB	TRAINING ON THE MANUFACTURE OF AGRICULTURAL	0	0	0	1		100	0	100	EEC
18AG0XC	TRAINING ON MAINTENANCE ASPECTS OF TRACTOR /COMBINE HARVESTER/POWER	0	0	0	1		100	0	100	EEC

18AG0XD	CUSTOM HIRING CENTRE	0	0	0	1		100	0	100	EEC
18AG0XE	AGRO PROCESSING CENTRE	0	0	0	1		100	0	100	EEC
18AG0XF	LANDSCAPE DESIGNING AND ARCHITECTURE	0	0	0	1		100	0	100	EEC
18AG0XG	MILLET PROCESSING AND COOKIES	0	0	0	1		100	0	100	EEC
18AG0XH	COCONUT PROCESSING AND VALUE ADDITION	0	0	0	1		100	0	100	EEC

18AG101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- Understand the concepts of vectors and Eigenvectors for different matrices to describe the stability of the linear systems in engineering fields.
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems.
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering systems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Execute the different forms of coordinate system in complex plane and characteristics of linear systems by Eigenvalues and Eigenvectors.
2. Analyse various types of functions and their differentiation techniques involved in engineering fields.
3. Implement different methods of integration used in engineering problems.
4. Execute the suitable integration technique to calculate the area and volume of different surfaces.
5. Apply the concept of analytic function to estimate the integral in complex plane.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2												
3	1	2												
4	1	2												
5	1	2												

UNIT I **9 Hours**

COMPLEX NUMBERS, VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices : Eigen values and Eigen vectors, Properties of eigen values and eigen vectors.

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and

differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus

UNIT III **9 Hours**

INTEGRATION METHODS

Basic integration formulae for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolle s Theorem, Mean Value Theorem, optimization, indeterminate forms, L Hospitals Rule.
Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution

UNIT V **9 Hours**

MULTIPLE INTEGRALS

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchy's Integral Formula - Classification of Singularities - Cauchy's Residue Theorem

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.
3. Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999
4. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995.
5. Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4thedition, McGraw Hill, 1999

18AG102 ENGINEERING PHYSICS I 2 0 2 3

Course Objectives

- Illustrate the Newtons laws of motion and wave motion withapplications
- Explain the applications of laser and fiber optics
- Implement the principles of quantum physics in the respective engineeringfields

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Assess the Newton's three laws of motion and apply the same to solve the real world problems involving elevator, at wood machine and acceleration of objects
2. Implement the different types of laser, optical fiber and its application in optic fiber communication system
3. Execute the properties, generation and applications of ultrasonic waves in engineering.
4. Assess seven crystal systems and compute the packing of atoms in crystal structures
5. Apply the basics of quantum mechanics, to setup one dimensional Schrodinger's wave equation and its application to the matter wave system

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2								2					
3	2	2												
4	2	2							2					
5	2	1							2					

UNIT I **6 Hours**

MECHANICS

Newton's laws of motion: Concept of force and its nature - Newton's first law and inertial frames - definition of mass - Newton's second law-gravitational force and weight - Newton's third law. Applications of Newton's laws: particle in equilibrium, particle under net force - weighing a mass in an elevator, the at wood machine and acceleration of two objects connected by a cord

UNIT II **6 Hours**

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion-energy of simple harmonic oscillator-spring mass system-time

period of simple pendulum, compound pendulum and torsional pendulum -Damped oscillations. Travelling wave motion - sinusoidal waves on strings-speed of a wave-reflection and transmission-rate of energy transfer in wave motion

UNIT III **6 Hours**

ELECTRICITY AND MAGNETISM

Point charges - electric fields - Gauss law and its applications - electric potential - capacitance-energy stored in a capacitor. Concept and source of magnetic fields - Amperes theorem -determination of magnetic field due to different current distributions - Faradays law - self-induction and mutual induction - energy stored in an inductor

UNIT IV **6 Hours**

LIGHT AND OPTICS

Nature of light - laws of reflection and refraction - refractive index and Snells law - dispersion of light - total internal reflection -image formation: concave mirrors - convex mirrors - thin lenses - compound microscope - human eye. Conditions of interference - Young's double slit experiment - intensity distribution of interference - phase change due to reflection - diffraction-narrow slit diffraction - single slit and two slit intensity distribution - diffraction grating - applications

UNIT V **6 Hours**

MODERN PHYSICS

Special theory of relativity- simultaneity and time dilation - twin paradox - length contraction - relativistic mass variation - space time graph. Black body radiation and Planck hypothesis - allowed energy levels - thermal radiation from different objects - photoelectric and Compton effect. Matter waves - de-Broglie hypothesis - wave nature of particles - Davission- Germer experiment

1 **5 Hours**

EXPERIMENT 1

Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

2 **5 Hours**

EXPERIMENT 2

Determination of moment of inertia-Torsional pendulum

3 **5 Hours**

EXPERIMENT 3

Determination of wavelength of mercury spectral lines-spectrometer

4 **4 Hours**

EXPERIMENT 4

Determination of refractive index of solid and liquid-travelling microscope

5 **3 Hours**

EXPERIMENT 5

Determination of wavelength of laser-diffraction grating

6 **4 Hours**

EXPERIMENT 6

Determination of frequency of a tuning fork-Melde apparatus

7 **4 Hours**

EXPERIMENT 7

Thickness of a thin wire using interference of light-Air wedge method

Total: 60 Hours

Reference(s)

1. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011
3. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017
4. H D Young and R A Freedman, Sears and Zemanss University Physics with Modern Physics, Pearson education, 2016

18AG103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Identify the metals used in agricultural machinery and its mechanical properties
- Compare the different types of corrosion and its protection methods
- Identify composition and applications of ferrous and non-ferrous alloys
- Recall the different heat treatment methods used in formation of alloys
- Explain the basic concepts of polymers, its preparation and processing methods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Find the properties of metal used for agricultural structures and machinery
2. Analyze the type of corrosion, factors influencing rate of corrosion on metals and identify suitable corrosion protection method
3. Assess the composition and properties of ferrous and non-ferrous alloys in agricultural applications
4. Find out the heat treatment method for production of alloys in agricultural machinery application
5. Differentiate polymers based on its source, properties and applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3													
2	2	1												
3	2	2												
4	2						1							
5	3	2												

UNIT I **6 Hours**

MECHANICAL PROPERTIES OF METALS AND ITS APPLICATIONS IN FARM EQUIPMENTS

Mechanical properties of metals - deformation - elastic and plastic deformation - stress and strain - tensile strength - hardness - ductility - toughness - brittleness - creep -malleability -resilience - stiffness - yield strength. Metals (iron, copper, zinc, lead, tin, aluminum) used in agricultural machinery manufacturing (axles, wheel spindles, shafts, gears) and structural applications (frames, roofing, doors)

UNIT II **6 Hours**

CORROSION IN AGRICULTURE

Types - chemical corrosion and electrochemical corrosion. Electrochemical corrosion: Galvanic corrosion and differential aeration corrosion. Factors influencing corrosion rate - corrosion control methods: Sacrificial anode and impressed current cathodic protection. Organic coating - paint, constituents and functions.

UNIT III **6 Hours**

FERROUS AND NON-FERROUS ALLOYS

Alloys: Purpose of alloying - function and effects of alloying elements - properties of alloys - classification of alloys. Composition - types - properties and applications of ferrous alloys (steel, cast iron, nichrome and stainless steel)- Non-ferrous alloys (brass and bronze).

UNIT IV **6 Hours**

HEAT TREATMENT

Heat treatment of steel: Annealing - stress relief -recrystallization and spheroidizing - normalizing - hardening - tempering of steel - carburizing - nitriding - cyaniding - carbonitriding - flame and induction hardening.

UNIT V **6 Hours**

POLYMER CHEMISTRY

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

FURTHER READING

Application of polymers in agriculture.Prevention of corrosion in agriculture machinery. Electrochemical instrumentation system for agriculture and the plant sciences.

1 **4 Hours**

EXPERIMENT 1

Laboratory Rules and Safety

2 **3 Hours**

EXPERIMENT 2

Estimation of copper deposited on iron rod using complexometric titration.

3 **4 Hours**

EXPERIMENT 3

Determination of electrical conductivity of different types of soil water

4 **4 Hours**

EXPERIMENT 4

Measurement of rate of corrosion on mild steel in aerated / neutral / acidic / alkaline medium by weight loss method

5 **3 Hours**

EXPERIMENT 5
Determination of Fe (II) in the given sample by spectrophotometrically

6 **4 Hours**

EXPERIMENT 6
Determination of the strength of Fe(II) in the given sample by potentiometric method.

7 **4 Hours**

EXPERIMENT 7
Estimation of the amount of mineral acid in soil by pH meter

8 **4 Hours**

EXPERIMENT 8
Determination of molecular weight of a polymer by Ostwald viscometer

Total: 60 Hours

Reference(s)

1. Bhaduri, Amit , Mechanical properties and working of metals and alloys, Springer Singapore, 2018
2. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
3. A. Pahari and B. Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010.
4. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013.
5. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, 1st Edition, New age International Publishers, New Delhi, 2014.

18AG104 BASIC ELECTRICAL ENGINEERING 2 0 2 3

Course Objectives

- To understand the basic concepts of electric circuits and magnetic circuits.
- To illustrate the construction and operation of various electrical machines and semiconductor devices.
- To learn the fundamentals of communication systems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Execute the measurement of electrical parameters and various meters used in the field of agriculture
2. Select a wiring layout for electric fence and farm house
3. Find the characteristics of induction motor in agriculture machineries
4. Analyze the need for safety in handling agriculture machineries and accessories used for protection
5. Assess the construction and operating characteristics of sensors used in agriculture applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1					2					1		
2	2	2	3	1										
3	2	3	1											
4	2	1		3										
5	2	2	3	1										

UNIT I **6 Hours**

MEASUREMENTS AND INSTRUMENTATION

Measurement of voltage, current, power, energy and power factor; Data loggers-grain, soil, water analyzers, soil compaction testers, soil tensiometers, lysimeter, lux meters

UNIT II **6 Hours**

FARM WIRING

Selection of wiring materials switches, wires, fuse and starters-single phase and three phase wiring-wiring layout for farm house and battery operated electric fence, types of battery, testing of battery: water level, voltage level, cable connections and temperature- charging methods

UNIT III **6 Hours**

ELECTRICAL MACHINES AND DRIVES

Construction and operating characteristics: Single and Three phase induction motor-selection of motors for agriculture drive systems: seeding, mowing and stripping applications.

UNIT IV **6 Hours**

SAFETY AND ACCESSORIES

Safety and maintenance of processing machineries: harvester -thresher -size reduction machines and farm house-pump house-MCB, ELCB, types of switches, safety equipment and earthing

UNIT V **6 Hours**

SENSORS

Operation and wiring layout: Location sensors-optical sensors- electrochemical sensors-dielectric sensors-soil moisture and temperature sensor -airflow sensors

FOR FURTHER READING

Voltage Regulator, Stepper motor, Energy meter, SMPS, Satellite and Optical communication.

1 **6 Hours**

EXPERIMENT 1

Charging and discharging of Lead- acid battery, Lithium-Ion battery, Nickel-Cadmium battery and Nickel- Zinc battery.

2 **6 Hours**

EXPERIMENT 2

House wiring: Loop-in system consists of single switch, two way switch, sockets with switches for light load and heavy load with ups wiring

3 **6 Hours**

EXPERIMENT 3

Wiring of water pump motor with main switch, starter, MCB, ELCB and earthing

4 **6 Hours**

EXPERIMENT 4

Earthing methods in battery operated electric fence and farm house

5 **6 Hours**

EXPERIMENT 5

Solar PV generation and storage system.

Total: 60 Hours

Reference(s)

1. R. Muthusubramanian, S. Salivahanan, Basic Electrical and Electronics Engineering, Tata McGraw-Hill Education, Reprint 2012.

2. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.

3. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010.

18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

- Read and understand the main points on familiar matters regularly encountered in work, school, or leisure
- Listen and respond in most common situations where English is spoken
- Write simple connected texts on topics which are familiar or of personal interest
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Preliminary exam level
2. Justify the general meaning of non-routine letters within own work area, and short reports of a predictable nature
3. Carry-out formal, routine letters of factual nature, and make notes on routine matters, such as taking/placing orders
4. Execute simple presentations/demonstrations
5. Select with predictable requests from a visitor, state routine requirements, and offer advice within own job area on simple matters

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2									2					
3														
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

UNIT II **9 Hours**

READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading forgist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

UNIT III **9 Hours**

WRITING

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

UNIT IV **9 Hours**

LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNIT V **9 Hours**

SPEAKING

Exchanging personal and factual information expressing and finding out about attitudes and opinions organise a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making. 1.Goodbye party for Miss Pushpa T S - NissimEzekiel 2.Our Casuarina Tree - Toru Dutt 3.Palanquin Bearers - Sarojini Naidu 4.The Tyger - William Blake 5.Ode on a Grecian Urn - John Keats

Total: 45 Hours

Reference(s)

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.

2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.

3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.

Course Objectives **18AG105 ENGINEERING DRAWING** **1 0 4 3**

- To provide knowledge on fundamentals of engineering drawings and conic sections.
- To impart skill on developing orthographic projections of points and lines.
- To familiarize about projection of planes and simple solids.
- To provide knowledge on section of solids and development of surfaces of simple solids.
- To impart skill on conversion of orthographic to isometric projections and vice versa

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Create an engineering drawing as per industrial standard.
2. Construct orthographic projections of points and lines.
3. Create projection of planes and simple solids.
4. Develop section of solids and surfaces
5. Design the conversion of orthographic to isometric and vice versa

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-							2	1				
2	2	-	-						2	1				
3	1								2	1				
4	1			-	-				2	1				
5	1				-				2	1				

UNIT I **15 Hours**

FUNDAMENTALS OF ENGINEERING DRAWINGS

Definition, standards, drawing tools, drawing sheets, scales, line and its types. Practices on lettering, numbering, dimensioning of drawings. Construction of conic sections-ellipse, parabola and hyperbola using eccentricity method.

UNIT II **15 Hours**

PROJECTION OF POINTS

Principles of projection, Projection of points in four quadrants, first angle projection of straight lines - perpendicularto one plane, parallel and inclined to both planes.

UNIT III **15 Hours**

PROJECTION OF PLANES AND SOLIDS

Projection of simple planes and projection of simple solids- parallel, perpendicular and inclined to one plane using change of position method

UNIT IV **15 Hours**

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Section of Solids-Simple position with cutting plane parallel, perpendicular and inclined to one plane. Development of surfaces - simple and truncated solids

UNIT V **15 Hours**

ORTHOGRAPHIC AND ISOMETRIC PROJECTION

Orthographic and isometric projection of components used in engineering applications.

Total: 75 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International, 2005.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards-Sp46, 2008
4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
5. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.

18AG201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.
- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Execute the various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Construct first order differential equations from real time phenomena and solve it by suitable method.
5. Execute the appropriate method to solve the second order differential equations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2												
3	1	2												
4	1	2												
5	1	2												

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications.

UNIT II **9 Hours**

MULTIPLE INTEGRALS

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only- Greens theorem and Gauss Divergence theorem).

UNIT III **9 Hours**

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

UNIT IV **9 Hours**

FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoullis equation, applications.

UNIT V **9 Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
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, 2014.

18AG202 ENGINEERING PHYSHICS II 2 0 2 3

Course Objectives

- To impart knowledge in crystallography and the crystal growth methods
- To understand the properties of conductors and semiconductors
- To familiarise basic concepts of force and system of forces in real worldenvironment
- To analyse the properties of surface and friction between thesurfaces

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Assess the seven crystal systems, crystal planes and the stacking sequences in metallic crystal structures
2. Execute the elastic behaviour of materials and assess the streamline and turbulent flow of liquids
3. Apply the conceptual knowledge to solve problems of particles and rigid bodies in two dimension under equilibrium conditions
4. Organize the properties of surfaces and solids using the parallel and perpendicular axis theorems
5. Differentiate between static and dynamic friction and analyse the equilibrium of bodies and on an inclined plane

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1							2					
3	2	2							2					
4	2	2							2					
5	2	2							2					

UNIT I **6 Hours**

CRYSTAL PHYSICS

Lattice - unit cell -Bravais lattice -lattice planes -miller indices -d-spacing in cubic lattice - calculation of number of atoms per unit cell - atomic radius - coordination number - packing density for SC, BCC, FCC and HCP structures -crystal growth: Bridgman and Czochralski techniques - X- ray diffraction.

UNIT II **6 Hours**

ELASTICITY AND VISCOSITY

Elasticity: elastic and plastic materials - Hookes law - modulii of elasticity - Poissons ratio and its

significance - elastic behaviour of a material stress - strain diagram uses - factors affecting elasticity - Youngs modulus - uniform bending and non-uniform bending - Viscosity: coefficient of viscosity - Reynold's number - streamline and turbulent flow of liquid

UNIT III **6 Hours**

EQUILIBRIUM OF PARTICLES AND RIGID BODIES

Introduction - system of forces - resultant force - determination of resultant force of concurrent force system. Equilibrant - Equilibrium of a particle Lamis theorem - free body diagram - types of supports and their reactions - moment of force - Varignons theorem - determination of resultant force systems: parallel, non-parallel, non-concurrent coplanar forces - equilibrium of rigid bodies in two dimensions

UNIT IV **7 Hours**

PROPERTIES OF SURFACES AND SOLIDS

Determination of area, volume and mass of centroid - Pappus and Guldinus theorem - moment of inertia of plane and area - parallel axis theorem - perpendicular axis theorem - product of inertia - mass moment of inertia - radius of gyration

UNIT V **5 Hours**

FRICTION

Frictional force - laws of Coulomb friction - angle of friction -cone of friction -equilibrium of bodies on an inclined plane - ladder friction-wedge friction-belt friction

1 **4 Hours**

EXPERIMENT 1

Determination of Young's modulus of the given beam using non-uniform bending method

2 **4 Hours**

EXPERIMENT 2

Determination of coefficient of viscosity of a given liquid using Poiseuilles method

3 **4 Hours**

EXPERIMENT 3

Experimental verification of parallelogram law of forces

4 **4 Hours**

EXPERIMENT 4

Experimental verification of Lamis theorem

5 **4 Hours**

EXPERIMENT 5

Determination of centroid of laminas

6 **4 Hours**

EXPERIMENT 6

Experimental analysis of the reaction forces of a simply supported beam and compare with the

analytical results

7 **3 Hours**

EXPERIMENT 7

Demonstration of tipping and sliding

8 **3 Hours**

EXPERIMENT 8

Determination of coefficient of friction between two surfaces

Total: 60 Hours

Reference(s)

1. Charles Kittel, Introduction to Solid State Physics, 8th Edition, Wile, India Pvt limited New Delhi 2012

2. Arthur Beiser, Shobjit Mahaja and S Rai Choudhury, Concepts of Modern Physics, 6th Edition, Tata McGraw Hil Education Pvt Ltd New Delhi, 2010

3. F.P. Beer, and Jr. E.R Johnston, Vector Mechanics for Engineers Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2007

4. N. H. Dubey, Engineering Mechanics - Statics and Dynamics, Tata McGraw-Hill Education Private Limited, New Delhi, 2013

5. D. P. Sharma, Engineering Mechanics, Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2010

6. S. Rajasekaran and G. Sankarasubramanian, Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., New Delhi, 2010

18AG203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Summarize the classical concepts of soil chemistry and familiarize students with modern developments in chemistry of soils in relation to using soils as a medium for plant growth
- Identify the chemical methods to use to check the soil properties
- Outline the fundamentals of soil biochemistry
- Outline the basic concepts of food and its structure
- Interpret concept of nano chemistry and their characterization techniques

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Execute the morphology of soil and electrometric properties of soil
2. Analyse the chemical impurities (metals & organics) present in the soil
3. Organize the type of nutrients present in soil and identify suitable biodegradation methods
4. Differentiate food molecules based on its physical and chemical properties
5. Select a suitable method for nanomaterial preparation and its characterization using AFM, SEM & TEM

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3													
2	3	2												
3	3	2												
4	2						1							
5	3						2							

UNIT I **6 Hours**

SOIL CHEMISTRY I

Chemical (elemental) composition of the earth's crust and soils. Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids.

UNIT II **6 Hours**

SOIL CHEMISTRY II

Soil organic matter - fractionation of soil organic matter and different fractions, clay-organic interactions. Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity. Chemistry of salt-affected soils and amendments; soil pH, EC , ESP, SAR and important relations; soil management and amendments. Chemistry and electrochemistry of submerged soils. Heavy metals in

contaminated soils and plants.

UNIT III **6 Hours**

SOIL BIOCHEMISTRY

Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil; biochemical composition and biodegradation of soil organic matter and crop residues, humus formation; cycles of important organic nutrients. Decomposition of organic matter in soil.

UNIT IV **6 Hours**

FOOD CHEMISTRY

Moisture in foods - structure - properties, types of water in food and their specific function. Lipids-classification - structures, physical and chemical properties. Carbohydrates - definition -classification - functions, properties of simple and complex carbohydrates. Proteins - introduction - classification and structures, physico-chemical properties, nutritive and supplementary value of food proteins. Pigments - introduction and significance of natural pigments in food - Chlorophylls, Carotenoids, Haemoglobin and Myoglobin, Anthocyanins, Flavonoids, Betalains Tannins.

UNIT V **6 Hours**

NANOTECHNOLOGY AND GREEN CHEMISTRY

Nano Materials: classification - properties - applications. carbon nanotubes: types (single and multiwall) - synthesis - top down and bottom up method (definition only) -Arc discharge method -pulsed laser deposition - chemical vapour deposition. Properties and applications of fullerenes, graphene C-60 bucky ball. Green chemistry: Twelve basic principles - need of green chemistry - applications. Designing of safer chemicals - alternative solvents. Microwave assisted synthesis.

FURTHER READING

Soil and water chemistry
The surface chemistry of natural particle

1 **3 Hours**

EXPERIMENT 1

Potentiometric and conductometric titration of soil humic

2 **3 Hours**

EXPERIMENT 2

Estimation of soil organic carbon

3 **3 Hours**

EXPERIMENT 3

Estimation of calcium content in the soil using EDTA method

4 **3 Hours**

EXPERIMENT 4

Estimation of chloride content in water by Argentometric method

5 **3 Hours**

EXPERIMENT 5
Estimation of chromium content in tannery effluent

6 **3 Hours**

EXPERIMENT 6
Estimation of protein from milk and egg by colorimetric methods

7 **3 Hours**

EXPERIMENT 7
Estimation of starch by (a) titrimetric method (b) calorimetric method

8 **3 Hours**

EXPERIMENT 8
Estimation of fat in the given sample

9 **3 Hours**

EXPERIMENT 9
Estimation of total ash content

10 **3 Hours**

EXPERIMENT 10
Preparation of metal (Ag and Cu) nano particles and its characterization

Total: 60 Hours

Reference(s)

1. Bolt GH & Bruggenwert MGM. Soil Chemistry. Elsevier,1978.
2. Greenland DJ & Hayes MHB. Chemistry of Soil Processes. John Wiley & Sons, 1981.
3. McBride MB. Environmental Chemistry of Soils. Oxford Univ. Press. 1994.
4. Sposito G. The Chemistry of Soils. Oxford Univ. Press. 1989. McLaren AD & Peterson GH. Soil Biochemistry. Vol. XI. MarcelDekker.1967. Paul EA & Ladd JN, Soil Biochemistry, Marcel Dekker,1981.
5. Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York, 1996. Potter,N.N.and Hotchkiss,J.H, Food Science, 5th Ed., Chapman & Hall,1995. DeMan, J.M., Principles of Food Chemistry, AVI, NewYork, 1980. Siavsankar B, Food Processing and Preservation, Prentice Hall India, 2004.
6. V K Ahluwalia, Green Chemsitry, ANE books, 2012. T Pradeep,Nano the essentials: understanding nano science and nanotechnology, Tata Mcgraw Hill, 1st edition, 2013.

18AG204 COMPUTER PROGRAMMING I 1 0 4 3

Course Objectives

- Understand the basics of C primitives, operators and expressions.
- Gain knowledge about the different primitive and user defined data types.
- Impart knowledge about the structural programming concepts.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Implement C programs using operators, type conversion and input-output functions.
2. Apply decision making and looping statements in writing C-programs.
3. Develop C programs using the concepts of Arrays and strings.
4. Design applications using functions in C.
5. Apply the concepts of structures and files in writing C programs.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3			3									
2	2	3			3									
3	2	3	-		3									
4	1	3			3									
5	1	3			3									

UNIT I **3 Hours**

INTRODUCTORY CONCEPTS

Introduction to C- Planning and writing a C program- Operators and Expressions- Arithmetic - Relational - Logical - Increment and decrement - Conditional - Bitwise - Comma - Sizeof() - Assignment - Shift operator Precedence and order of evaluation

UNIT II **3 Hours**

CONTROL STATEMENTS

Decision Making and Branching- Decision Making and Looping -Jump Statements.

UNIT III **3 Hours**

ARRAYS AND STRINGS

Arrays- Introduction, declaration - Initialization of one dimensional array, two-dimensional arrays, initializing two dimensional arrays. Strings- String handling functions.

UNIT IV **3 Hours**

FUNCTIONS

User Defined Functions-Elements of user defined functions -categories of function -call by value and call by reference -recursion

UNIT V **3 Hours**

STRUCTURES AND FILES

Structures - Introduction - defining a structure - declaring structure variables - accessing structure members -File Management in C.

FURTHER READINGS

Problem solving - Logical thinking - logic - symbolic logic - truth tables - Math puzzles - magic triangles - magic squares - alphabetic puzzles - Cross number puzzles.

1 **3 Hours**

EXPERIMENT 1

Implement a C program which include a Fundamental Data types Integer, Float, double and Character.

2 **6 Hours**

EXPERIMENT 2

Implement a C program to perform the Arithmetic Operations using primitive data types.

3 **6 Hours**

EXPERIMENT 3

Implementation of logical, relational, bitwise, increment/decrement and conditional Operators in C.

4 **6 Hours**

EXPERIMENT 4

Implementation of Simple if else Conditional Statement.

5 **5 Hours**

EXPERIMENT 5

Implementation of nested if else Conditional Statement.

6 **3 Hours**

EXPERIMENT 6

Implementation of Switch Case Statement.

7 **3 Hours**

EXPERIMENT 7

Implement a C program using for Looping Statement.

8 **3 Hours**

EXPERIMENT 8
Implement a C program using Do-While Looping Statement

9 **3 Hours**

EXPERIMENT 9
Implement a C program using While Looping Statement.

10 **3 Hours**

EXPERIMENT 10
Implementation of Jumping Statements

11 **3 Hours**

EXPERIMENT 11
Implementation of One Dimensional Array.

12 **6 Hours**

EXPERIMENT 12
Implementation of Two Dimensional Array.

13 **3 Hours**

EXPERIMENT 13
Implement a C program to perform String Manipulation Functions.

14 **4 Hours**

EXPERIMENT 14
Implement a C program using structures.

15 **3 Hours**

EXPERIMENT 15
Implement a C program which includes four categories of functions and recursive functions.

Total: 75 Hours

Reference(s)

1. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2017
2. Byron Gottfried , Programming with C, Schaum's Outlines, Tata Mcgraw-Hill, 2013
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Kernighan B W and Ritchie O M, The C programming Language. Prentice-Hall of India, 2009
5. Kelley A and I. Pohl, A Book on C : Programming in C, Pearson Education, 1998
6. Ashok.N.Kamthane,Programming in C,Pearson education,2013

18AG205 PRINCIPLES OF CROP PRODUCTION TECHNOLOGY 2 0 2 3

Course Objectives

- To study about the basic principles of crop production aspects
- To learn the cultivation practices of varies field crops to increase the food production
- To impart basic knowledge of insect pest and diseases and their losses caused to crops.
- To study various methods of plant protection to get more yield in agricultural crops

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1.Implement the concepts and principles of crop growth, climate influence, soil fertility and tillage for increase the crop productivity

2.Apply the various agronomic inputs for raising different crops under organic or intensive cultivation through use of improved varieties or hybrids and the liberal use of irrigation, fertilizers and weed management to increase the food production.

3.Assess the groups of insects, diseases and their damage symptoms to identify the better management practices

4. Apply the various cultivation practices for major cereals, millets, minor millets and pulse crops

5. Apply the various cultivation practices for major oil seeds, cotton and sugarcane

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	1	-				2		1			3		
2		3	1		1				1			2		
3			1	-								1		
4		1	3											
5		1	3											

UNIT I **6 Hours**

PRINCIPLES OF AGRONOMY

Definition of agriculture and agronomy - Factors affecting crop growth - climate and weather parameters - Soil fertility and productivity - tillage and tilth - objective and principles - different kinds of tillage - Organic farming - principles and practices

UNIT II **7 Hours**

AGRONOMIC INPUTS AND CROPPING SYSTEM

Seeds of varieties or hybrids - seed treatment - sowing and planting methods - Manures and fertilizers - source, nutrient contents and methods of application - Irrigation techniques for different soils and crops - Weeds - classification of weeds - principles and methods of weed management - Intensive cultivation - monoculture and multiple cropping - inter, mixed, relay, strip and multitier cropping - Practices of organic crop cultivation

UNIT III **8 Hours**

PLANT PROTECTION

Group of pests and Diseases - Methods of control - Cultural, Physical, Chemical and Biological - Pest management in major crops - Organic way of plant protection.

UNIT IV **5 Hours**

AGRONOMY OF FIELD CROPS I

Package of practices for important field crops - rice, maize, sorghum, finger millet and small millets - Pulses - red gram, black gram, green gram, soybean

UNIT V **4 Hours**

AGRONOMY OF FIELD CROPS II

Package of practices for groundnut, gingelly and sunflower, cotton, sugarcane

FOR FUTHRE READING

Modern techniques used to cultivate the major field crops and organic way of food production-Mode of spread of pest and diseases, prophylactic measures to manage pests mode of action of pesticides, complex problems in plant protection

1 **2 Hours**

EXPERIMENT 1

Acquiring skill on the organizational setup of the agricultural farm and studying basic requirements of crop production

2 **3 Hours**

EXPERIMENT 2
Studies of climatic factors on crop growth - meteorological instruments

3 **2 Hours**

EXPERIMENT 3
Practicing different sowing / planting methods; fertilizers and irrigation methods

4 **3 Hours**

EXPERIMENT 4
Practicing different weed management practices; cropping system in intensive or organic farming

5 **3 Hours**

EXPERIMENT 5
To identify the damage symptoms of pest and diseases

6 **3 Hours**

EXPERIMENT 6
Study the integrated pest and diseases management practices

7 **2 Hours**

EXPERIMENT 7
Practicing cultivation operations of major cereal crops

8 **4 Hours**

EXPERIMENT 8
Practicing cultivation operations of major pulse crops

9 **4 Hours**

EXPERIMENT 9
Practicing cultivation operations of major oil seed crops

10 **4 Hours**

EXPERIMENT 10
Practicing cultivation operations of cotton and sugarcane crop

Total: 60 Hours

Reference(s)

1. SP. Palaniappan, and S. Sivaraman. 1998. Cropping systems in the tropics- Principles and Management, New Age international publishers, New Delhi, (2nd edition), 1998.

2. P.Balasubramain and SP. Palniappan. 2001. Principles and Practices of Agronomy, Agrobios publishers, Ludhiana.

3. T. Yellamanda Reddy and G.H. Sankara Reddi. 2014. Principles of Agronomy, Kalyani publishers, Ludhiana

4. B.Chandrasekaran, B., K. Annadurai and E. Somasundaram. 2007. A Text book of Agronomy, Scientific publishers, Jodhpur.

5. N. Dhandapani and S. Uthamasamy. 2000. Integrated pest Management. TNAU Publications, Coimbatore.p.181.

6. K. Justin. 2004. Crop protection. TNAU, petchipaarai, kanyakumari Dt.p.379.

18AG207 ENGINEERING PRACTICES LABORATORY 0 0 4 2

Course Objectives

- To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools.
- To gain the skills for making fitting joints and household pipe line connections using suitable tools.
- To develop the skills for preparing the green sand mould and to make simple household electrical connection
- To provide hands on training for dismantling and assembling of petrol engines, gear box and pumps.
- To develop the skills for making wood/sheet metal models using suitable tools

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Course Outcomes (COs)

1. Construct simple components using carpentry, sheet metal and welding equipment/tools
2. Carry-out fitting joints and household pipe line connections using suitable tools.
3. Execute electrical connections for farm structures using suitable tools
4. Carry-out dismantle and assemble petrol engines, gear box and pumps.
5. Execute simple models using wood and sheet metal.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2													
2	1													
3	1													
4	1													
5	2													

1 **6 Hours**

EXPERIMENT 1

Forming of simple object in sheet metal using suitable tools (Example: Float for weeder)

2 **6 Hours**

EXPERIMENT 2

Fabrication of a simple component using thin and thick plates. (Example: Weeder frame and pegtooth)

3 **6 Hours**

EXPERIMENT 3

Making a simple component using carpentry power tools. (Example: Door ,window frames for farm structures).

4 **6 Hours**

EXPERIMENT 4
Prepare a "V" (or) Half round (or) Square joint from the given mild Steel flat.

5 **6 Hours**

EXPERIMENT 5
Construct a pipe line connections using pipes, Tee joint, Four way joint, elbow, union, bend, Gate way and Taps

6 **6 Hours**

EXPERIMENT 6
Construct a pipe connections of farm application centrifugal pump using pipes, bend, gate valve, flanges, pressure relive valve and foot valve.

7 **6 Hours**

EXPERIMENT 7
Construct a domestic electrical wire connections using indicator, one way switch

8 **6 Hours**

EXPERIMENT 8
Dismantling and assembly of Centrifugal Monoblock / Gear Pump / Gear box.

9 **6 Hours**

EXPERIMENT 9
Dismantling and assembly of two stroke and four stroke petrol engine.

10 **6 Hours**

EXPERIMENT 10
Mini Project (Fabrication of Small Components).

Total: 60 Hours

18AG301 ENGINEERING MATHEMATICS III 3 1 0 4

Course Objectives

• Understand the concepts of Fourier series, Transforms and Boundary Conditions, which will enable them to model and analyze the physical phenomena

• Implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields

• Summarize and apply the mathematical aspects that contribute to the solution of one dimensional wave equation

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Assess the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series
2. Execute a function in frequency domain whenever the function is defined in time domain.
3. Compute a partial differential equation and able to solve them.
4. Apply the concepts of probability in Agriculture engineering to forecast the yields ofcrops.
5. Apply basic statistical inference techniques, to science/engineering problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	-											
2	3	3												
3	2	2												
4	2	2												
5	2	3												

UNIT I **10 Hours**

FOURIER SERIES
Fourier series for periodic functions. Orthogonal functions. The Euler coefficients- Harmonic analysis.

UNIT II **9 Hours**

FOURIER TRANSFORMS
Fourier Integral Theorem- Fourier Transform and Inverse Fourier Transform- Sine and Cosine Transforms - Properties - Transforms of Simple Functions - Convolution Theorem - Parsevals Identity

UNIT III **9 Hours**

PARTIAL DIFFERENTIAL EQUATION
Introduction to partial differential equations. One-dimensional wave equation. Method of separation of variables. De Alemberts solution of the wave equation. Heat equation. Laplace equation. Telegraph equations.

UNIT IV **10 Hours**

PROBABILITY THEORY
Probability. Random variables, probability densities and distributions, mean and variance of a distribution. Conditional probability. Bayes theorem. Binomial, Poisson and normal distributions.

UNIT V **9 Hours**

BASIC STATISTICS
Mean, Median, Mode, Variance, Standard Deviation, Covariance, Correlation and Regression

Total: 60 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley,1993
2. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John
3. Wiley, 1996. ONeil Peter V., Advanced Engineering Mathematics, 4th Edition, PWS-Kent, 1995.
4. Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and
5. Applications for Engineering and The Computing Sciences, McGraw Hill Inc, 3rd Edition,1995
6. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993.

18AG302 ENGINEERING THERMODYNAMICS 3 0 0 3

Course Objectives

- To study the fundamentals of thermodynamics and zeroth law
- To provide the knowledge on first law of thermodynamics
- To impart the knowledge on second law of thermodynamics and entropy
- To study the thermodynamic properties of pure substances and its phase change processes
- To learn about gas power cycles and properties of gas mixtures

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Execute the basic concepts and zeroth law of thermodynamics
2. Apply the first law of thermodynamics to closed and open systems
3. Solve the problems related to cycles and cyclic devices using second law of thermodynamics
4. Determine the thermodynamic properties of pure substances and its phase change processes
5. Evaluate the air standard performance of heat engines and properties of gas mixtures

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3								-		3		
2	3	3					1			2		3		
3	3	3					2					3		
4	3	3			1		2			2		3		
5	3	3	1	1	1	2		-		2		3		

UNIT I **9 Hours**

CONCEPTS AND FIRST LAW OF THERMODYNAMICS

Basic Concepts - concept of continuum, Macroscopic approach. Thermodynamic systems - Closed, Open. Control volume. Thermodynamic properties and equilibrium state of a system. Path and process. Quasi Static process. Modes of work. Zeroth law of thermodynamics. Concept of temperature and heat. First law of thermodynamics - Applied to closed and open systems-isolated systems. Internal energy. Specific heat at constant volume (Cv) and Specific heat at constant pressure (Cp). Enthalpy-Limitations of Laws of thermodynamics.

UNIT II **9 Hours**

SECOND LAW OF THERMODYNAMICS

Second law of thermodynamics - Kelvin Planck and Clausius statements. Reversibility and Irreversibility. Clausius inequality. Entropy concept-a point function or a property of a system efficiency, Principle of increase of entropy - Change of entropy during thermodynamic processes. Carnot theorem- absolute entropy-availability. CARNOT CYCLE Coefficient of Performance of heat pumps and refrigerator.

UNIT III **9 Hours**

PROPERTIES OF PURE SUBSTANCES

Thermodynamic properties of pure substances in solid, liquid and vapour phases, Pressure-Volume (P-V), Pressure - Temperature (P-T), Temperature - Volume (T-V), Temperature - Entropy (T-S), Enthalpy - Entropy (H-S), Pressure-Volume-Temperature (P-V-T) diagrams. Thermodynamic properties of steam - Calculations of work done and heat transfer in non-flow and flow process

UNIT IV **9 Hours**

PROPERTIES OF GASES, THERMODYNAMIC RELATIONS

Concept of ideal and real gases. Equation of state. Avagadro's law. Vander Waal's equation of states. Dalton's law of partial pressure. Properties of mixture of Gases. Maxwell relations. Temperature-Change in entropy (T-dS) equation. Clausius-Clayperon equations. Joule Thomson Coefficient. Amagat's Law. Gibbs Function.

UNIT V **9 Hours**

AIR STANDARD CYCLES AND PSYCHROMETRY

Air standard cycles - Otto, Diesel and Dual, Calculation of mean effective pressure and Air standard efficiency. Rankine cycle concept of ideal- Psychrometric chart.

Total: 45 Hours

Reference(s)

1. Y. Cengel and Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2003
2. Rayner Joel, Basic Engineering Thermodynamics, Pearson Publications, 2012.

3. S. Khurmi, text book of thermodynamics and Heat transfer, S. Chand Publications, New Delhi, 2002.

4. C. P. Arora, Thermodynamics, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2003.

5. R. S. Khurmi, Steam table with Psychometric chart, S. Chand Publications, New Delhi, 2002.

6. Merle C. Potter, Craig W. Somerton, Thermodynamics for Engineers, Schaum Outline Series, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2004.

18AG303 FLUID MECHANICS 3 0 2 4

Course Objectives

- To study the different properties of fluids
- To analyze pattern and nature of the flow of fluids in pipes and open channel
- To gain an understanding of flow measurements and hydraulic machines

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Execute the fundamental properties of fluids and measures of pressure in fluid statics
2. Organize the fluid flow and its pattern
3. Assess the rate of flow of fluids using flow measuring devices
4. Design the most economical channel section and measure the flow in channels.
5. Assess the performance of pumps based on characteristic curves

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-											
2	3	2	-											
3	3	2	1											
4	2	3	-											
5	2	3	-											

UNIT I **9 Hours**

PROPERTIES OF FLUIDS

Properties of fluids- definition -units of measurement - Measurement of pressure by various types of manometers - Hydrostatic forces on surfaces -total pressure and center of pressure – Horizontal vertical and inclined plane surface - Archimedes principles - buoyancy - metacenter -metacentricheight

UNIT II **9 Hours**

FLUID FLOW ANALYSIS

Types of fluid flow - velocity and acceleration of a fluid particle - Flow pattern-velocity potential stream function. Principles of conservation of mass -energy-momentum - continuity equation in Cartesian co-ordinates.

UNIT III **9 Hours**

FLOW MEASUREMENTS

Euler's equation of motion - Bernoulli's equation - applications - Venturimeter - orifice meter, Rotometer -

Pitot tube- Flow through pipes - laminar and turbulent flow in pipes - Darcy Weisbach equation for friction head loss - Chezy's formula - Major and minor losses in pipes-turbines s

UNIT IV **9 Hours**

OPEN CHANNEL FLOW

Types of flow in channel - Most economical section of channel - rectangular -trapezoidal. Specific energy and critical depth - Specific force - critical flow - computation. Flow measurement in channels - notches - rectangular, triangular

UNIT V **9 Hours**

PUMPS AND DIMENSIONAL ANALYSIS

Centrifugal pumps - components- working - specific speed - characteristics curves. Submersible pumps - Jet pump- reciprocating pump-Dimensional analysis -concept of geometric, kinematic and dynamic similarity. Important non dimensional numbers.

FOR FURTHER READING

Newtonian and Non Newtonian fluids- Stream line, Streak line, Path line, Time line - Application of Bernoulli's Equation - Pipes in series - Equivalent pipe - Model and Prototype - Similitude

1 **2 Hours**

EXPERIMENT 1

Find the friction factor of fully developed flow through pipes of various diameters.

2 **2 Hours**

EXPERIMENT 2

Determination of Co-efficient of discharge of Venturimeter

3 **2 Hours**

EXPERIMENT 3

Determination of Co-efficient of discharge of V-notch

4 **2 Hours**

EXPERIMENT 4

Determination of Co-efficient of discharge of orifice meter

5 **4 Hours**

EXPERIMENT 5

Conduct a test and submit the characteristic report on Centrifugal pump

6 **4 Hours**

EXPERIMENT 6

Conduct a test and submit the characteristic report on Submersible pump

7 **4 Hours**

EXPERIMENT 7

Conduct a test and submit the characteristic report on Reciprocating pump

8 **4 Hours**

EXPERIMENT 8
Conduct a test and submit the characteristic report on Jet pump

9 **2 Hours**

EXPERIMENT 9
Conduct a test and submit the characteristic report on Gear Pump

10 **2 Hours**

EXPERIMENT 10
Study on the performance characteristics of Francis turbine

11 **2 Hours**

EXPERIMENT 11
Study on the performance characteristics of Pelton wheel turbine

Total: 75 Hours

Reference(s)

1. Yunus A. Cengel, John M. Cimbala, Fluid Mechanics-Fundamentals and Applications, Tata McGraw Hill Publishing Co, New Delhi, 2006.
2. R.K. Bansal, A text book of Fluid Mechanics and Hydraulic Machinery, Laxmi publications (P) Ltd, New Delhi, 2002.
3. K. Subramanya, Flow in Open Channels, Tata McGraw Hill Publishing Co, New Delhi, 2009.
4. P.N. Modi and S.M. Seth, Hydraulics and Fluid mechanics, Standard Publishers & Distributors, New Delhi.
5. RJ. Grade, Fluid mechanics through problems, Wiley eastern Ltd, Chennai, 2002.
6. Jagadish Lal, Hydraulic machines, Metropolitan book house, New Delhi, 2000.

18AG304 STRENGTH OF MATERIALS 3 1 0 4

Course Objectives

- To impart the knowledge on heat transfer mechanisms in fluids and solids, and their applications in various heat transfer equipment
- To analyze heat exchangers and methods of evaluating the performance
- To introduce non-dimensional numbers and their effects in governing various modes of mass transfer.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public
health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering
and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable
development

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Course Outcomes (COs)

1. Find the stresses and strains for different geometries
2. Asses the concepts and types of convertion in heat transfer mechanism
3. Resolve the radiation problems in various gcomeries
4. Analyze the performance of heat exchangers and evaporators
5. Find the various modes of mass transfer and apply them in engineering problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	1										
2	2	3	1	1	1		-							
3	3	2	1	-	1	-								
4	1	3	2		-	-								
5	3	2	1	1										

UNIT I **9 Hours**

BASICS OF STRESSES AND STRAINS

Simple Stresses and Strains Hookes Law Modulus of Elasticity Principle of Superposition bars of varying sections thermal stresses and strains Elastic Constants - Poissons Ratio Bulk Modulus - Shear Modulus - interrelationships - Strain Energy and Impact Loading Proof Resilience - Modulus of Resilience - Principal Stresses and Strains - Oblique sections Analytical method - Graphical method (Mohrs Circle method)

UNIT II **9 Hours**

CENTRE OF GRAVITY AND MOMENT OF INERTIA

Centroid and Centre of Gravity -geometrical considerations - method of moments - Plane (laminae) sections - symmetrical sections - unsymmetrical sections - solid bodies and sections with cut our holes - Moment of Inertia Routh rule - method of integration - Theorem of Parallel axes - Theorem of Perpendicular axes - geometric sections - solid and hollow sections - composite and built-up sections

UNIT III **9 Hours**

ANALYSIS OF FRAMED STRUCTURES (TRUSSES)

Structures built of Frames - Types of Frames - Perfect and imperfect frames - deficient and redundant frames - Loads and stresses - Method of Joints - Method of sections - Graphical method - Bownotations - polar diagram- funicular polygon- vector diagram - cantilever trusses - freely supported trusses - King Post and Queen Post Trusses

UNIT IV **9 Hours**

SHEAR FORCE, BENDING MOMENT AND DEFLECTION (BEAMS)

Uniformly distributed load and gradually varying load -Shear Force and Bending Moment distributions - Theory of Simple Bending - Bending stress - modulus of section - deflection in beams and cantilevers - Double integration method- Macaul method.

UNIT V **9 Hours**

COLUMNS, SHELLS AND SHAFTS

Columns and struts - Slenderness ratio - Buckling and crushing - Euler Column theory - applications - Rankine formula-Johnson formula - Indian Standards - Shells -Cylindrical and spherical shells- thin and thick shells - Shafts - torsion in circular shafts - Polar Moment of Inertia - strain energy due to torsion.

Total: 60 Hours

Reference(s)

1. Rajput, R.K. Strength of Materials (Mechanics of Solids). 4th edition. S.Chand & CompanyLtd. India, 2010.

2. Ramamrutham, S. Strength of Materials. 16th edition. Dhanpat Rai Publishing Co., India, 2008.

3. Khurmi, R.S. Strength of Materials (Mechanics of Solids). 24th Edition. S.Chand & Company Ltd, India, 2013.

18AG305 SOIL MECHANICS 3 0 2 4

Course Objectives

- To acquire the knowledge on engineering geology and basic geomorphic processes
- To impart knowledge on applied geomorphology and hydrogeology
- To gain knowledge on soil mechanics and the procedures to test the soil interns of dam and reservoir construction

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Organize the basic geomorphic processes
2. Apply suitable technique/procedure in dam and reservoir construction
3. Assess the permeability of soil using suitable techniques
4. Execute the concepts of soil and water relationship
5. Analyze the fundamental concepts of soil strength

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	3											
2	2	2	3	2	2		1							
3	1	3	1	2			1							
4	1	3	2	1			1							
5	1	3	1	2										

UNIT I **9 Hours**

GEOLOGY AND APPLIED GEOLOGY

Introduction to Geology and Engineering Geology - importance - Earth's layers -Geological Structures - Geomorphology - Concepts - Processes and Forms - Fluvial and Eolian Geomorphology- Drainage analysis-Watershed characteristics - Channel Geomorphology

UNIT II **10 Hours**

ENGINEERING PROPERTIES OF SOIL

Introduction to Soil mechanics - Physical characteristics of soil - soil texture-Particle size distribution - analysis - Grain size distribution curves - Sedimentation analysis -Stokelaw- assumptions -validity- soil structure types- Soil phase relationship, mass volume relationship, weight -volume relationship - Index properties of soils determination of specific gravity-soil water-Soil Classification field identification soil consistency - Atterberg limits - liquid limit, plastic limit and shrinkage limit-Relative density of cohesion less soils.

UNIT III **9 Hours**

PERMEABILITY

Permeability - Darcy's law-discharge velocity validity of Darcys law- seepage velocity - Factors affecting permeability - Permeability through layered soil -Measurement of permeability - Flow net construction-characteristics.

UNIT IV **8 Hours**

COMPACTION AND CONSOLIDATION

Compaction - objectives -relationship with water content- the Standard Proctor compaction test - Factors affecting compaction-methods of compaction in field - Compressibility -coefficient of Compressibility - Consolidation of soils -stages of consolidation.

UNIT V **9 Hours**

STRENGTH OF SOILS

Shear strength-concept of shearing resistance and shearing strength - Coulomblaw - Mohr's circle of stresses - Earth pressure at rest - active pressure - passive pressure - Stability of slopes - Stability of earthen embankments,-Bearing Capacity of soil -Testing &Improving Bearing Capacity of soil

1 **2 Hours**

EXPERIMENT 1

Determination of Field Density by Core cutter and Sand Replacement methods

2 **2 Hours**

EXPERIMENT 2

Mechanical analysis of Soil Sieving

3 **4 Hours**

EXPERIMENT 3

Hydrometer analysis for Grain Size Distribution

4 **2 Hours**

EXPERIMENT 4

Determination of Atterbergs Limits of Soil Consistency

5 **4 Hours**

EXPERIMENT 5

Determination of Hydraulic Conductivity by Constant Permeameter, Variable Head Permeameter

6 **4 Hours**

EXPERIMENT 6
Field method of determination of Coefficient of Permeability

7 **4 Hours**

EXPERIMENT 7
Proctor Compaction test of soils-Consolidation test of soils

8 **2 Hours**

EXPERIMENT 8
Direct Shear Test-Vane Shear Test of soils

9 **2 Hours**

EXPERIMENT 9
Problems on Bearing Capacity, permeability, compaction and compressibility

10 **4 Hours**

EXPERIMENT 10
Field visit Landslides areas and control measures

Total: 75 Hours

Reference(s)

1. Yunus A. Cengel, John M. Cimbala, Fluid Mechanics-Fundamentals and Applications, Tata McGraw Hill Publishing Co, New Delhi, 2006.

2. R.K. Bansal, A text book of Fluid Mechanics and Hydraulic Machinery, Laxmi publications (P) Ltd, New Delhi, 2002.

3. K. Subramanya, Flow in Open Channels, Tata McGraw Hill Publishing Co, New Delhi, 2009.

4. P.N. Modi and S.M. Seth, Hydraulics and Fluid mechanics, Standard Publishers & Distributors, New Delhi.

5. RJ. Grade, Fluid mechanics through problems, Wiley eastern Ltd, Chennai, 2002.

6. Jagadish Lal, Hydraulic machines, Metropolitan book house, New Delhi, 2000.

18AG306 SURVEYING AND LEVELLING 3 0 0 3

Course Objectives

- To acquire the knowledge on engineering geology and basic geomorphic processes
- To gain knowledge on soil mechanics and the procedures to test the soil interns of dam and reservoir construction
- To impart knowledge on applied geomorphology and hydrogeology

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Select the instruments required for conducting the chain survey in level and sloping ground
2. Assess the area of the land by chain surveying and also can apply the necessary chain corrections
3. Assess the area and volume of earth work by simple and numerical methods
4. Execute the angle between the stations by prismatic compass and conduct the plane table surveying for locating the new stations
5. Find the Reduced level for all points by using dumpy level, prepare the contour map and also identify the horizontal, vertical angle using Theodolite.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3											
2	2	1	3	2	2									
3	1	3	1	2			1							
4	1	3	2	1	-		1							
5	1	3	1	2		-	1							

UNIT I **9 Hours**

PRINCIPLES OF SURVEYING

Introduction - Principles and basic concepts and uses of surveying - classification and basic methods of surveying- Types of chains, Ranging rod, Ranging - Direct and Indirect methods-Obstacles in chaining. Chain Surveying - Principles of chain surveying - - cross staff and optical square - Steps involved in Chain Survey

UNIT II **9 Hours**

LEVELLING AND CONTOURING

Basic terminologies of Compass traversing- Prismatic and Surveyors Compass - Checking the accuracy of traverse - Errors and mistakes in Compass survey - Plane tabling - instruments and accessories - Radiation, Traversing, Orientation - Intersection and Resection.

UNIT III **9 Hours**

THEODOLITE AND MODERN SURVEYING

Theodolite - Types - Description - Horizontal and vertical angles - Temporary and Permanent adjustments Heights and distances Tangential and Stadia Tacheometry Subtense methods - Stadia constants - Anallactic lens - Traversing - Gales table - Total Station- Global Positioning System (GPS)-GNSS

UNIT IV **9 Hours**

COMPASS TRAVERSING AND PLANE TABLE SURVEYING

Levelling - definition - Benchmarks - different types of levels - Basic principles of leveling – Theory of simple, compound, cross sectional and reciprocal levelling -Contouring - definition -contour characteristics - direct and indirect methods -gradient contour - uses

UNIT V **9 Hours**

COMPUTATION OF AREA AND VOLUME

Introduction - Formulate for calculation of cross sectional area- calculation of volume - Area computation, Mid-Ordinate rule- Average ordinate rule- Trapezoidal rules- Simpson rule and Coordinatemethod

FOR FURTHER READING

Merits and demerits of plane table surveying - Description and uses of theodolite - Omitted measurements - Description and uses of total station-Radial contouring - Modern Trends in surveying and advance equipment.

Reference(s)

1. Punmia. B.C Surveying (Vol- I & Vol-II) Laxmi publications, New Delhi. 1991.
2. Kanetkar, T.P. & Kulkarni, S.V., Surveying & leveling Part I, A.V.G.
3. Basak. V.N. 1994.Surveying and Levelling, Tata McGraw hill publications, New Delhi
4. A.M. Michael and T.P. Ojha Agricultural Engineering (Vol-II), New Delhi

18AG307 COMPUTER PROGRAMMING II 1 0 4 3

Course Objectives

- Understand the basics of C primitives, operators and expressions.
- Gain knowledge about the different primitive and user defined data types.
- Impart knowledge about the structural programming concepts

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Implement Object Oriented Programming concepts and basic characteristics of Java
2. Assess the principles of inheritance and interfaces
3. Find the exceptions and use polymorphism in various functions
4. Carry-out a java application with generics classes and use I/O Streams
5. Assess the importance of OOP in real-world problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3			3									
2	2	3	-	-	3									
3	2	3	-	-	3									
4	1	3			3	-		-						
5	1	3			3									

UNIT I **7 Hours**

BASICS OF JAVA

Object Oriented Programming - Abstraction - Objects and Classes - Encapsulation- Inheritance - Polymorphism - Characteristics of Java - The Java Environment - Java Source File- Structure - Compilation.

Fundamental Programming Structures in Java - Defining classes in Java Constructors, Methods - Access specifiers - Comments, Data Types, Variables, Operators, Control Flow, Arrays Packages

UNIT II **6 Hours**

INHERITANCE AND INTERFACES

Inheritance- Super classes- Sub classes -Protected members - Constructors in sub classes - Abstract classes and methods -final methods and classes -Interfaces - Defining an interface, implementing interface, Differences between classes and interfaces -Strings - String Operations- String Buffer - String Builder

UNIT III **5 Hours**

POLYMORPHISM AND EXCEPTION HANDLING

Polymorphism- Abstract Classes and Methods - Varieties of Polymorphism - Polymorphic Variables- Overloading and Overriding -Exceptions - exception hierarchy - Throwing and Catching exceptions-Built-in exceptions, Creating own exceptions.

UNIT IV **6 Hours**

GENERIC PROGRAMMING AND I/O STREAMS

Generics Types - Generic Classes and Methods - Wild Cards and Type Erasure -Restrictions on Generics - Input / Output Basics - Streams - Byte streams and Character streams -Reading and Writing Console - Reading and Writing Files.

UNIT V **6 Hours**

EVENT DRIVEN PROGRAMMING FILES

Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy- Introduction to Swing - layout management - Swing Components- Text Fields- Text Areas - Buttons - Check Boxes - Radio Buttons - Lists- Choices- Scrollbars - Windows pMenus - Dialog Boxes.

FURTHER READINGS

Problem solving - Logical thinking - logic - symbolic logic - truth tables - Math puzzles - magic triangles - magic squares - alphabetic puzzles - Cross number puzzles.

1 **4 Hours**

EXPERIMENT 1

Programs using class and methods

2 **2 Hours**

EXPERIMENT 2

Programs on Package implementations

3 **4 Hours**

EXPERIMENT 3

Inheritance implementation

4 **2 Hours**

EXPERIMENT 4

Inheritance via Interface and Abstract class

5 **4 Hours**

EXPERIMENT 5
Application using Exception handling

6 **2 Hours**

EXPERIMENT 6
Programs on Polymorphism

7 **4 Hours**

EXPERIMENT 7
File handling using IO streams

8 **2 Hours**

EXPERIMENT 8
Desktop applications using Applet

9 **2 Hours**

EXPERIMENT 9
Implement a C program using While Looping Statement.

10 **4 Hours**

EXPERIMENT 10
Implementation of Jumping Statements

11 **5 Hours**

EXPERIMENT 11
Implementation of One Dimensional Array.

12 **2 Hours**

EXPERIMENT 12
Implementation of Two Dimensional Array.

13 **4 Hours**

EXPERIMENT 13
Implement a C program to perform String Manipulation Functions.

14 **2 Hours**

EXPERIMENT 14
Implement a C program using structures.

15 **2 Hours**

EXPERIMENT 15
Implement a C program which includes four categories of functions and recursive functions.

Total: 75 Hours

Reference(s)

1. Herbert Schildt, Java: The Complete Reference, 11th Edition, McGraw Hill Education, Dec 2018.

2. Cay S Horstmann, Gary Cornell, Core Java Volume - I Fundamentals,9th Edition, Prentice Hall, 2013.

3. Cay S Horstmann, Gary Cornell, Core Java Volume - II Advanced Features,9th Edition, Prentice Hall, 2013.

4. Kernighan B W and Ritchie O M, The C programming Language. Prentice-Hall of India, 2009

5. Rajkumar Buyya, S Thamarai Selvi, Xingchen Chu, Object Oriented Programming with Java: Essentials and Applications, Tata McGraw Hill Education Private Limited, 2009

6. Bert Bates, Kathy Sierra, Head First Java, 2nd Edition, OReilly Media, 2005.

18AG308 SURVEYING AND LEVELLING LABORATORY 0 0 2 1

Course Objectives

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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Demonstrate the various functional aspects of surveying instruments
2. Execute topographic map including contours of any site
3. Assess a highway road alignment project and Calculate the area and volume of earthwork
4. Assess the land area using Total Station and GPS
5. Assess the Differential levelling in field and Profile levelling plotting

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	2	3										
2	1	2	3		3									
3	1	-	2	-		-								
4	1	3			3	-		-						
5	1	3			3									

1 **4 Hours**

EXPERIMENT 1

Linear measurement and Area computation by cross staff survey and plotting

2 **2 Hours**

EXPERIMENT 2

Chain traversing of cropped area and error correction.

3 **4 Hours**

EXPERIMENT 3
Compass Survey - radiation method-Closed compass traversing, Plotting and correction of closing error

4 **2 Hours**

EXPERIMENT 4
Open compass traversing-Problems on Compass traversing

5 **2 Hours**

EXPERIMENT 5
Area computation by plane table survey - radiation method

6 **4 Hours**

EXPERIMENT 6
Plane table survey - intersection -Plane table traversing resection methods

7 **2 Hours**

EXPERIMENT 7
Measurement of horizontal

8 **4 Hours**

EXPERIMENT 8
Measurement of area using Total Station and GPS

9 **4 Hours**

EXPERIMENT 9
Dumpy level- handling - shifting- Simple levelling - temporary adjustments -Differential levelling in field- Profile levelling plotting

10 **2 Hours**

EXPERIMENT 10
Mid-ordinate rule, Average ordinate rule, Trapezoidal rule, Simpson rule and Coordinate method of finding area problems

Total: 30 Hours

Reference(s)

1. Punmia. B.C "Surveying (Vol- I & Vol-II)" Laxmi publications, New Delhi. 1991

18GE301 SOFT SKILLS - VERBAL ABILITY 0 0 2 0

Course Objectives

- To help students gain adequate proficiency in vocabulary
- To read and understand unabridged text
- To help students become proficient in basic writing skills related to work placecommunication

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Take up verbal ability part of the placement tests withconfidence
2. Write with confidence in professional and workplace communication
3. Distinguish fact from opinion by reading passages from atext

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2											2			
3									2					

UNIT I **15 Hours**

INTRODUCTION

Synonyms - Antonyms - Word Groups - Verbal Analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text & Paragraph Completion.

UNIT II **15 Hours**

BASICS OF VERBAL APTITUDE

Sentence Formation - Paragraph Formation - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence - Jumbled Sentences - Spotting Errors -Homophones Homonyms - Commonly Mispronounced/Misspelt Words.

Total: 30 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use A Self-Study Reference and Practice Book for Intermediate Learners of English. IV Edition. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. Word Power Made Easy. New York: Pocket Books. 1991.
3. Baron"s The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc.2015.

18AG401 NUMERICAL METHODS AND STATISTICS 3 1 0 4

Course Objectives

• Understand the methods to solve polynomial equations and Implement the mathematical ideas for interpolation numerically.

• 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

• Summarize and apply the design of experimental methodologies involved in solving problems related to engineering problems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Execute the equations into algebraic, transcendental or simultaneous and apply the techniques to solve them numerically.
2. Find the interpolation, differentiation and integration of functions using the numerical techniques.
3. Compute the occurrence of numerical errors.
4. Apply basic statistical inference techniques, including confidence intervals, hypothesis testing to science/engineering problems.
5. Apply the concept of design of experiment to science/engineering problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-												
2	2	2												
3	3	-												
4	3	3												
5	3	-												

UNIT I **10 Hours**

NUMERICAL SOLUTION OF BOUNDARY VALUE PROBLEM

Single and multi-variable nonlinear equations, convergence of fixed point iterations. Least squares approximation, Normal equations. Polynomial interpolation and cubic spline interpolation. Single step methods, Runge-Kutta methods. Multi-step methods. Finite Difference Methods.

UNIT II **10 Hours**

NUMERICAL SOLUTIONS OF SYSTEM OF LINEAR EQUATIONS

Systems of linear equations: The Gaussian elimination method and the Gauss-seidal method. Eigenvalues and eigenvectors by Power method, Inverse of a Matrix by Gauss-Jordan method.

UNIT III **6 Hours**

ERROR ANALYSIS

Errors, Truncation and round off errors, measurement errors, Chebychevs Polynomial and data filtering.

UNIT IV **10 Hours**

MATHEMATICAL STATISTICS

Sample mean and variance. Sampling distributions. Statistical estimation of parameters, confidence intervals. Testing of hypotheses, one-sample and two-sample inferences. Applications to statistical quality control and reliability analysis.

UNIT V **9 Hours**

DESIGN OF EXPERIMENTS

Completely randomized design - Randomized block design - Latin square design

Total: 60 Hours

Reference(s)

1. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 3rdEdition, John Wiley, 1996.

2. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Eastern Economy Edition, New Delhi.

3. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley,1993

4. Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and Applications for Engineering and The Computing Sciences, McGraw Hill Inc, 3rd Edition,1995

18AG402 HEAT AND MASS TRANSFER 3 0 2 4

Course Objectives

- To impart the knowledge on heat transfer mechanisms in fluids and solids, and their applications in various heat transfer equipment
- To introduce non-dimensional numbers and their effects in governing various modes of mass transfer
- To analyze heat exchangers and methods of evaluating the performance

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Assess conduction of heat in different geometries
2. Assess the concepts and types of convection in heat transfer mechanism
3. Execute the radiation problems in various geometries
4. Analyse the performance of heat exchangers and evaporators
5. Find the various modes of mass transfer and apply them in engineering problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	1	-									
2	2	3	1	1	1									
3	3	2	1		1	-	-							
4	1	3	2				-		-					
5	3	2	1	1			-		-	-				

UNIT I **9 Hours**

CONDUCTION

Basic concepts - Mechanism of Heat transfer. Conduction - Fourier"s Law, General differential equation in Cartesian and cylindrical coordinates, one dimensional steady state heat conduction, conduction through plane wall, cylinders and spherical systems.

UNIT II **9 Hours**

CONVECTION

Basic Concepts - Heat transfer coefficients, boundary layer concept. Types of convection - Forced convection, dimensional analysis, non-dimensional numbers, external flow, flow over plates, cylinders and spheres, internal flow, laminar and turbulent flow, combined laminar and turbulent.

UNIT III **9 Hours**

RADIATION

Radiation heat transfer - concept of black and grey body-Laws of Radiation - Stefan-Boltzmann Law, Kirchhoff"s Law Black body radiation - Grey body radiation - Shape factor algebra - Radiation shields

UNIT IV **9 Hours**

HEAT EXCHANGERS

Heat exchangers - Types, heat exchanger analysis, fouling factor, LMTD (Logarithmic mean temperature difference) and Effectiveness-NTU (number of transfer units) Method - Overall Heat Transfer Coefficient

UNIT V **9 Hours**

MASS TRANSFER

Mass transfer- introduction - Fick 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

FOR FURTHER READINGS

Application of Heat and Mass transfer in Food Processing industries.

1

2 Hours

EXPERIMENT 1

Calculate the thermal conductivity of lagged pipe

2 **4 Hours**

EXPERIMENT 2
Determination of thermal conductivity of metal rod

3 **2 Hours**

EXPERIMENT 3
Calculate the thermal conductivity of insulating material

4 **2 Hours**

EXPERIMENT 4
Determination of heat transfer co-efficient by natural convection

5 **2 Hours**

EXPERIMENT 5
Determination of heat transfer co-efficient by forced convection

6 **2 Hours**

EXPERIMENT 6
Determination of heat exchanger test - parallel and counter flow

7 **4 Hours**

EXPERIMENT 7
Determine the thermal conductivity of guarded hot plate

8 **4 Hours**

EXPERIMENT 8
Determination of Stefan-Boltzmann constant

9 **4 Hours**

EXPERIMENT 9
Determination of emissivity using emissivity apparatus

10 **4 Hours**

EXPERIMENT 10
Determine the thermal conductivity of guarded hot plate

Total: 75 Hours

Reference(s)

1. R. C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International private limited, New Delhi, 2010

2. Yunus A. Cengel, Heat and Mass Transfer: a Practical Approach, Tata McGraw Hill publishing Company private limited, New Delhi, 2007

3. J. P. Holman, Heat Transfer, Tata McGraw Hill publishing Company private limited, New Delhi, 2009

4. C. P. Kothandaraman and S. Subramanyan, Fundamentals of Heat and Mass Transfer, New Age International private limited, New Delhi, 2014

5. Frank P. Incropera,Fundamentals of Heat and Mass Transfer, John Wiley, New Delhi, 2007
6. Heat and Mass Transfer, S Chand and Company, New Delhi, 2009

18AG403 HYDROLOGY 3 1 0 4

Course Objectives

- To acquire knowledge about the fundamentals of water occurrence and their exploitation
- To understand the hydrology of surface and ground water
- To understand well hydraulics so as to locate wells for the extraction of groundwater

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel

Course Outcomes (COs)

1. Execute the hydrologic cycle and measure the interception losses including evaporation, transpiration, infiltration and infiltration indices
2. Organize the methods of estimation of runoff and construct the hydrographs based on different methods
3. Differentiate the types of geological formations classify the aquifer based on the occurrence of groundwater
4. Assess the ground water flow and estimate the aquifer parameters by following various methods based on the groundwater movement and geological formation
5. Assess the well losses and yield for well development and design of open and bore well including its diameters, depth and screen

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2		1		1	1		1				1	
2	1	2	2	3		1								
3	3	-	3	2									2	
4	2	2		3		-	1		-					
5	-		3	2			1		-	-			1	

UNIT I **9 Hours**

HYDROLOGIC CYCLE AND INITIAL LOSSES

Hydrologic cycle- Precipitation - Forms and measurement of precipitation - Water losses interception loss- evaporation- transpiration - infiltration -infiltration capacity mechanics of infiltration-Factors influencing the rate of infiltration measurement of infiltration infiltration equations Infiltration indices - index W index problems.

UNIT II **9 Hours**

RUNOFF

Stream types - run off process - phases of runoff process factors affecting run off Different methods of Estimation of runoff Intensity, duration, frequency relationship Estimation of runoff by empirical formulae Stream flow and stream gauging

UNIT III **9 Hours**

HYDROGRAPH

Hydrograph- Hydrograph components - base flow separation - Unit hydrograph - unit hydrograph theory - purposes of unit hydrograph - Derivation of unit hydrograph for multiple durations from unit hydrograph of specified duration super position technique and curve method.

UNIT IV **9 Hours**

GROUNDWATER FLOW

Groundwater- development- potential in India- Aquifer properties- Land subsidence due togroundwater withdrawal-Types of aquifer - confined unconfined perched artesian- aquifuge - aquiclude Movement of groundwater Darcys law- Water table contour maps- Flow net analysis -Groundwater flow potential, unconfined-steady 1-dflow- with recharge, confined 1d-flow-Continuity equation derivation - Hydraulics of wells- Steady radial flow into wells-Unsteady state confined aquifer-Theis method, Jacob method.

UNIT V **9 Hours**

WELLS

Recuperation test- Leaky artesian aquifer-unsteady radial flow -Unconfined aquifer- unsteady radial flow, Image well theory -Partially penetrating wells-Well losses-Step draw down test- yield -Geophysical investigation-Surface methods -Subsurface methods -Wells design-diameter- depth- screen- Open well versus bore wells- design-bore wells- infiltration galleries- Well development -yield testing.

FOR FURTHER READING

Flood routing and reservoir operation, well drilling machineries pumps and their maintenance.

Total: 60 Hours

Reference(s)

1. Subramanya, K., Engineering Hydrology, Tata McGraw Hill pub Co. New Delhi, 2004
2. Raghunath, H.M., Groundwater, Wiley Eastern Ltd. Madras, 2003
3. Gurmel Singh et al.Manual of soil and water conservation practices, Oxford & IBH publishing Co. New Delhi,2005
4. Suresh, R.Land and water management principles, Standard Publishers & Distributors, New Delhi,2008
5. H.P. Garg, Advances in Solar Energy Technology Volume 2, Industrial Applications of Solar Energy, ISBN: 978-94-010-8188-7 (Print), Springer Publications., 1987.
6. Jui Sheng Hsieh, Solar Energy Engineering, Prentice Hall, London, 1986

18AG404 PRODUCTION TECHNOLOGY OF HORTICULTURAL CROPS **2 0 2 3**

Course Objectives

- To impart knowledge on horticultural crops such as fruits, vegetables, flowers and plantation crops and their cultivation techniques to increase the production
- To acquire the knowledge on the nursery production techniques, landscape design and management.
- Learn the management of crops including soil / irrigation / pest and diseases management
- To learn about harvesting, handling, value addition and storage of horticultural products

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Execute the various cultivation practices for raising different horticultural crops such as fruits, vegetables, cut flowers, potted plants, bedding plants, and bulbs and floral design
2. Implement the concepts and principles of dry land, garden land horticulture and precision farming
3. Assess the production technology of fruits and vegetables medicine plants
4. Execute the various harvesting methods for fruits and vegetables
5. Analyse the various harvesting methods, pre cooling, packaging and storage methods of horticultural crops

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1	2					3			1			
2	3	1	2	-	-	2					1			
3	1	-	3					2			1			
4	1						3							
5		2												

UNIT I **6 Hours**

FUNDAMENTALS OF HORTICULTURE

Horticulture - Definition - scope and importance - Division and classification of horticultural crops Fruits, Vegetables, Flowers, Plantation crops, medicinal crops and their significance - Nutritive value of horticultural crops

UNIT II **6 Hours**

PROPAGATION AND CROP MANAGEMENT TECHNIQUES

Nursery techniques - propagation of Propagation - definition - propagation methods - seed propagation- vegetative propagation - Weed management - irrigation and moisture conservation - Nutrition of horticultural crops and application methods in horticultural crops

UNIT III **6 Hours**

PRODUCTION TECHNOLOGY OF FRUITS AND VEGETABLES

Production techniques of mango, banana, grapes, citrus, pomegranate, guava - Production techniques of brinjal, bhendi, tomato, chillies, cole vegetables, cucurbits viz., pumpkin, bitter gourd, snakegourd, ribbed gourd and greens

UNIT IV **6 Hours**

PRODUCTION OF FLOWRS, PLANTATION AND MEDICINAL CROPS

Cultivation practices of folwer crops viz., rose, jasmine, Tuberose, chrysanthemum - cultivation practices of plantation crops viz., coconut, arecanut, tea, coffee - cultivation of medicinal plants viz.,Coleus, Ocimum, mint

UNIT V **6 Hours**

POST HARVEST TECHNOLOGY AND MACHINERIES

Tools and machineries utilized for cultivation, protection and harvesting of horticultural crops - Postharvest techniques - processing and value addition - storage - package - marketing and export potential of horticulture produce

FOR FURTHER READING

Production of organic horticulture products by avoiding chemical fertilizers and pesticides -Case studies on commercial horticultural ventures and precision farming

1

2 Hours

EXPERIMENT 1

Practicing cultivation of vegetables-bhendi/ tomato/ brinjal crops

2 **2 Hours**

EXPERIMENT 2
Identification and production techniques for fruit crops.

3 **4 Hours**

EXPERIMENT 3
Identification and production techniques for commercial flower crops.

4 **4 Hours**

EXPERIMENT 4
Identification and production techniques for plantation crops- coconut& areca nut

5 **2 Hours**

EXPERIMENT 5
Identification and production techniques for medicinal and aromatic crops.

6 **4 Hours**

EXPERIMENT 6
Practicing different techniques for seeds/ seedling production/ propagation methods–budding and grafting

7 **4 Hours**

EXPERIMENT 7
Practicing different Irrigation/ fertilizer application and weed management practices.

8 **4 Hours**

EXPERIMENT 8
Lawn making landscape designing.

9 **4 Hours**

EXPERIMENT 9
Value addition techniques for horticulture produces

Total: 60 Hours

Reference(s)

1. Thamburaj, S., M.Kannan and V.Kanthaswamy.1997. Horticultural crop varities released from TNAU.KRS offset printers Coimbatore.
2. Veeraragavathatham, D 1998. A Guide on vegetable culture. Suri Associates, Coimbatore.
3. George Acquaah. 2002. Horticulture-principles and practices, Prentice-Half of India Pvt. Ltd., New Delhi.
4. Veeraragavathatham, M 2004 Scientific fruit culture. Suri Associate, Coimbatore.
5. Sarangi, A.B and S.Datta 2015. Value addition of horticultural crops. Springer, Delhi.
6. Gupta, S.N. 2016. Instant horticulture, Jain brothers, New Delhi.

18AG405 TRACTOR AND FARM ENGNIES 3 0 0 3

Course Objectives

- To acquire an in-depth knowledge on farm tractors and engine systems
- To acquire knowledge on test procedures to assess the performance of tractors and power tillers
- To develop skills on safe and efficient use of tractors

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel

Course Outcomes (COs)

1. Implement the knowledge on tractors, power tillers and their functions
2. Execute and rectify problems in the functioning of tractors and power tillers
3. Use the knowledge on test procedures to assess the performance of tractors and power tillers
4. Use the knowledge on ergonomic aspects of tractors and power tillers
5. Execute the economics of operation of tractors and power tillers

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-		2							1		
2	3	2	-		2	1						1	1	
3	1	2	1		-			3						
4	-	-		-	3	2	-	-						
5	-			2			-		-	3			1	

UNIT I **9 Hours**

ENGINE SYSTEMS 1

Classification of tractors - Tractor engines construction of engine blocks, cylinder head and crankcase - features of cylinder, piston, connecting rod and crankshaft firing order- combustion chambers.

UNIT II **9 Hours**

ENGINE SYSTEMS 2

Valves-inlet and outlet valves valve timing diagram. Air cleaner- exhaust silencer. Cooling systems - lubricating systems - fuel system governor- electrical system.

UNIT III **9 Hours**

TRANSMISSION SYSTEMS

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

UNIT IV **9 Hours**

HYDRAULIC SYSTEMS

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

UNIT V **9 Hours**

POWER TILLER AND TRACTOR TESTING

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.

Total: 45 Hours

FOR FURTHER READING

Testing procedures available at Bhudni tractor testing centre, Madhya Pradesh- comparative evaluation of specifications of different tractors and power tillers

Reference(s)

1. Rajeev Kumar, Farm Power and Machinery Engineering (English), First Edition, Standard publishers and distributors, New Delhi. ISBN-10 8180140253, 2008

2. Arun Dahake, An Introduction to Farm Power and Machinery, ISBN No. 9781312800885, (Standard Copyright License), 1st Edition, www.lulu.com, 2015

3. Donnell Hunt, Farm Power and Machinery Management, Publisher: Iowa State Press, ISBN 0813805821, 1995.

4. Barger,E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units, Wiley Eastern Pvt. Ltd., New Delhi, 1997

5. Jain,S.C. and C.R. Rai, Farm tractor maintenance and repair. Standard publishers and distributors, New Delhi, 1999

18AG406 FARM STRUCTURES AND GREEN HOUSE TECHNOLOGY 3 1 0 4

Course Objectives

- To develop theoretical and practical knowledge on the various components of afarmstead
- To develop theoretical and practical knowledge on the various animal housing
- To gain the knowledge on the design of different types and components of farm structures
- To impart knowledge on design and construction of farm structures

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding
of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Implement the basics of farmstead construction and determine suitable site for their construction
2. Design poultry house, dairy barn and aquaculture systems
3. Design farm feed and storage structures and assess the factors influencing storage structure design
4. Design roads, water supply system and septic tanks for the farms
5. Apply the knowledge to design green house structures

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	2	1	1						1		
2	2	3	3	2	1	1						1		
3	2	3	3	1	2	1	-					1		
4	2	3	3	1	2	1						1		
5	2	3	3	1	2	1						1		

UNIT I **9 Hours**

FARMSTEAD PLANNING AND GRAIN STORAGE

Different types of farm buildings- farm site selection- building arrangement- indigenous food grain storage structures- need for good storage- modern grain storage and concrete bins- threshing and dryingfloors.

UNIT II **9 Hours**

HOUSING OF DAIRY CATTLE AND POULTRY

Planning and designing dairy barns- stall barns and loose houses- milking parlor-waste management - poultry housing requirements- common types of poultry houses and their planning- introduction to aquacultural systems

UNIT III **9 Hours**

FARM FEED STORAGE STRUCTURES AND MACHINERY SHED

Silo-requirement- Types of silo, over ground, underground and others- Design of silos- covered an open spaces -Machinery sheds- Site selection-Types and shapes of building- Space requirements- Farm shops, building requirement and space requirement- Fencing, types of fences-fence posts

UNIT IV **9 Hours**

RURAL ROADS, FARM WATER SUPPLY AND SEWAGE DISPOSAL

Survey and planning- Geometrical design- Pavement design- Construction and maintenance- Typical rural culverts of different sizes, their hydraulic and structural design and construction- Sources of water supply- Estimation of quantity for different consumption-Capacity requirements of storage tanks- distribution systems- Design of septic tanks and sanitary structures

UNIT V **9 Hours**

GREEN HOUSES

Types- Functional design-Structural material and design-Orientation, ventilation, cooling and types of cladding material Type design - Water management in green houses

Total: 60 Hours

Reference(s)

1. T.P. Ojha and Michael, A. M. Principles of Agricultural Engineering, Vol.-I (Sixth Edition), Jain Brothers, New Delhi. 2012.
2. H.N. Van Lier, CIGR Handbook of Agricultural Engineering, Vol. I-Land and Water Management Engineering, ASAE, USA. 1999.
3. E. H. Bartali and W.Frederick, CIGR Handbook of Agricultural Engineering, Vol. IIAnimal Production and Aquacultural Engineering, ASAE, USA. 1999.

4. M.Raghupathi, Design of steel structures Tata McGraw Hill Pub. Com. New Delhi 110006, 2005 B.C.Punmia, Reinforced concrete structures Vol. I Laxmi publications, 7/21, Ansari Road, Dhryaganj, New Delhi 110 002, 2005.

18AG407 TRACTOR AND FARM ENGINES LABORATORY 0 0 4 2

Course Objectives

- To acquire an in-depth knowledge on farm tractors and engine systems
- To develop skills on safe and efficient use of tractors
- To acquire knowledge on test procedures to assess the performance of tractors and powertillers

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Execute the components in tractors, power tillers and their functions
2. Assess and rectify problems in the functioning of tractors and power tillers
3. Outline ergonomic aspects of tractors and power tillers
4. Assess the components in fuel system assembly and their functions
5. Assess the components in transmission system-assembly and their functions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	1											
2	2	3	-		-									
3	1		2			1	1							
4	1		2			1	1							
5	1		2			1	1							

1 **2 Hours**

EXPERIMENT 1

Hand tools used in garage - fault diagnosis

2 **6 Hours**

EXPERIMENT 2
Dismantling of engine from tractor - engine disassembly (CI engine)

3 **4 Hours**

EXPERIMENT 3
Piston and cylinder- inspection- reconditioning and assembly of cranking system.

4 **4 Hours**

EXPERIMENT 4
Reconditioning and assembly of valve and valve actuation system

5 **6 Hours**

EXPERIMENT 5
Servicing of fuel system assembly and adjustment

6 **6 Hours**

EXPERIMENT 6
Servicing of fuel system assembly and adjustment

7 **4 Hours**

EXPERIMENT 7
Servicing and assembly of cooling system components

8 **6 Hours**

EXPERIMENT 8
Study of Gear transmission train - clutch - dismantling, inspection and reconditioning - adjustment

9 **6 Hours**

EXPERIMENT 9
Dismantling of transmission system-assembly of gear box, differential and final drive

10 **6 Hours**

EXPERIMENT 10
Brake and its adjustment-Steering system - assembly and adjustment-wheel tread adjustment

11 **4 Hours**

EXPERIMENT 11
Study of tyres, rims and balancing methods of a tractor

12 **6 Hours**

EXPERIMENT 11
Operation of tractors and power tillers

Reference(s) **Total: 60 Hours**

1. Arun Dahake, An Introduction to Farm Power and Machinery, ISBN No. 9781312800885, (Standard Copyright License), 1st Edition, www.lulu.com, 2015

18AG408 COMPUTER AIDED DESIGN LABORATORY 0 0 4 2

Course Objectives

- 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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Carry-out two dimensional drawings of engineering components using standard CAD Modelling package
2. Design a three dimensional assembly model consisting of many components with tolerances.
3. Design animations from three dimensional assembly models by applying various motion constraints.
4. Show dimensional assembly models of two wheeler suspension system by applying various motion constraints.
5. Design a three dimensional assembly model of simple energy conversion/power transmission system and animate its working using modeling software.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	2	-	1									
2	2	2	-	3	1									
3	1	1												
4	2	2	-	3	1									
5	2	2	-	3	1									

1 **4 Hours**

EXPERIMENT 1
Introduction to modeling software: Practicing sketching, Dimensioning and Modelling Tools and Creating simple 3D models by using any CAD Modelling Software

2 **6 Hours**

EXPERIMENT 2
Create a orthographic views of machine components from isometric component drawing

3 **6 Hours**

EXPERIMENT 3
Create a two dimensional sketch diagrams of simple machine components

4 **6 Hours**

EXPERIMENT 4
Create a three dimensional assembly model of bearing from detailed orthographic drawings

5 **6 Hours**

EXPERIMENT 5
Create a three dimensional assembly model of bearing from detailed orthographic drawings

6 **6 Hours**

EXPERIMENT 6
Create a three dimensional assembly model of I C Engine components from detailed orthographic drawings

7 **6 Hours**

EXPERIMENT 7
Create a three dimensional assembly model of gear box from detailed orthographic drawings

8 **6 Hours**

EXPERIMENT 8
Create a three dimensional assembly model of two wheeler suspension system from detailed orthographic drawings

9 **6 Hours**

EXPERIMENT 9
Create a three dimensional assembly model of valves from detailed orthographic drawings

10 **6 Hours**

EXPERIMENT 10
Create a three dimensional assembly model of simple mechanism and animate its working in modeling software

11 **2 Hours**

EXPERIMENT 11

Create a three dimensional assembly model of simple energy conversion/power transmission system and animate its working using modeling software

Total: 60 Hours

Reference(s)

1. KJ Bathe, Finite Element Procedures, PHI Learning, 2007
2. Rao S. S., The Finite Element Method in Engineering, Elsevier, 6th Edition, 2017
3. Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite Elements in Engineering, Pearson Education, 4th Edition 2012
4. David V Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Education, 2009

18HS001 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Execute the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Find the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Assess the impacts of population and human activities on environment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	1												
3	2	2					1							
4	1													
5	2													

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources: renewable (solar, wind, and hydro).

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers -decomposers

food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution : (Sewage water treatment by activated sludge and trickling filter process) - noise pollution- thermal pollution. Disaster management: causes - effects - control measures of floods - earthquake

UNIT IV **7 Hour**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development : Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. E-waste.

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

FOR FURTHER READING

Human rights: Biomedical waste -Identification of adulterants in food materials

Total: 30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

18GE401 SOFT SKILLS-BUSINESS ENGLISH 0 0 2 0

Course Objectives

- To acquire command of both the receptive skills (Listening, Reading) and the productive skills (Writing and Speaking) of English language
- To understand and make effective use of English language in business contexts

Programme Outcomes (POs)

a. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

b. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen, Read, Speak, and Write Business English at the level of independent users
2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge Assessment English

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1					
2										2				

UNIT I **15 Hours**

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

UNIT II **15 Hours**

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising - reassuring - complaining - describing - summarising - recommending - persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

Total: 30 Hours

Reference(s)

1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self - study Practice Tests with Key, Heinle - a part of Cengage Learning, Delhi, 2003.

21AG501 FARM IMPLEMENTS AND EQUIPMENT 3 0 0 3

Course Objectives

- To learn about the different types of primary and secondary tillage implements, farm equipment and different ploughing methods
- To know about the tools and techniques used for a wide variety of different types of farming operations and landscaping
- To utilise the power tools and mounted implements with the tractor

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post-harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Execute the knowledge on tillage and its objectives
2. Execute the knowledge on farm mechanization
3. Implement and rectify problems in the functioning of farm implements andequipment

4.Assess the optimization of machine operations according to the local needs and the characteristics of the crops, thereby can help the farmers in executing precision farming to increase the agricultural production.

5.Assess the farmers to achieve increased labor productivity, improved yield, reduced input materials, reduced human work load and reduced losses.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	1		2								
2	3	1	1	-	2	2								
3	3	2	1	2		2								
4	3	1	1			2	-		-				1	
5	3		2			1		-	-	-	-		1	1

UNIT I **8 Hours**

FARM MECHANIZATION

Farm mechanization - objectives. Tillage - objectives - 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 **10 Hours**

PRIMARY TILLAGE IMPLEMENTS

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, chisel plough - Rotary plough - spading machine - coir pith applicators.

UNIT III **9 Hours**

SECONDARY TILLAGE IMPLEMENTS

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

UNIT IV **9 Hours**

SOWING AND INTERCULTURAL EQUIPMENT

Crop planting - methods - row crop planting systems. Seeding machines- Devices for metering seeds - furrow openers - furrow closers - types - Types of seed drills and planters-seed drill calibration - application of fertilizers - metering devices - seed cum fertilizer drill - application of liquid fertilizers. Plant protection equipment - sprayer - classification - types - duster - types - weeders - manual, power operated - wet, dry land.

UNIT V **9 Hours**

HARVESTING, THRESHING AND TESTING OF FARM IMPLEMENTS

Combine harvester - paddy, sugarcane, maize - grains harvester - thresher - multi crop thresher - digger - tapioca, potato, onion - cotton picker, groundnut harvester - fruit harvesting equipment. Testing of primary tillage equipment - MB plough, disc, chisel and sub soiler plough. Testing of secondary tillage equipment - cultivator, rotavator, disc harrow, testing of seed cum fertilizer drill, planter, sprayer.

FOR FURTHER READING

Ergonomics and Automation - Ergonomic aspects of farm implements - automation of agricultural machinery - latest developments in automation by referring to international and national journals in agricultural engineering

Total: 45 Hours

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. Journal of Agricultural Engineering (JAE). Indian Society of Agricultural Engineers. New Delhi - 110012

4. Agricultural Engineering Today (AET). Indian Society of Agricultural Engineers. New Delhi - 110012

5. Transactions of American Society of Agricultural and Biological Engineers. ISSN- 0001-2351

6. Soil and Tillage Research, ISSN-0167-1987

21AG502 SOIL AND WATER CONSERVATION ENGINEERING 3 1 0 4

Course Objectives

- To acquire the fundamental understanding of soil conservation practices and erosion control structures
- To develop skills on water conservation and harvesting
- To provide knowledge on watershed development and management

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Organize the causes of soil erosion, types of soil erosion and assess the total soil loss for watershed
2. Design the gully control structures for controlling the landslides
3. Design the agronomic and mechanical measures for controlling soil erosion
4. Organize the water harvesting structures for insitu and exsitu water conservation
5. Execute the watershed development programme with land capability classification for watershed management

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	-	3		1	1		1				3	
2	-	2	-	3		1								1
3	3		-	2									2	
4	2	2	-	3	-		1							
5		-	3	2			1	-	-					

UNIT I **9 Hours**

SOIL EROSION

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 **9 Hours**

EROSION CONTROL

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 **9 Hours**

GULLY CONTROL STRUCTURES

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

UNIT IV **8 Hours**

WATERSHED MANAGEMENT

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

UNIT V **8 Hours**

WATER HARVESTING

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

FOR FURTHER READING

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

Lecture: 45 Hours
Tutorial: 30 Hours
Total: 75 Hours

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

21AG503 UNIT OPERATIONS IN AGRICULTURAL PROCESS ENGINEERING 3 0 0 3

Course Objectives

- To introduce scope, importance and key concepts of agro processing
- To 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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Execute the evaporation process and types of evaporators for foodindustry
2. Analyze the principles of filtration and mechanical separation equipment
3. Assess the size reduction and grinding equipment and understand the factors affecting the process
4. Find the gas-liquid and solid-liquid equilibrium concepts and factors influencing equilibrium separation process.
5. Differentiate crystallization and distillation processes and identify processing equipment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	-	-	1		1							2
2	-	3	2	1			1							
3	2	1	3	-	-		1							1
4	2	1		3			1							1
5	2	1	1	3			1		-		-	-		1

UNIT I **8 Hours**

EVAPORATION AND CONCENTRATION

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 **8 Hours**

MECHANICAL SEPARATION

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 **9 Hours**

SIZE REDUCTION AND MIXING

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 **10 Hours**

CONTACT EQUILIBRIUM SEPARATION

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 - 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 **10 Hours**

CRYSTALLIZATION AND DISTILLATION

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.

FOR FURTHER READINGS

Unit operations involved in various food processing.

Total: 45 Hours

Reference(s)

1. Geankoplis,C.J., Transport Process and Unit Operations, Prentice-Hall of India Private Limited, New Delhi, 1999

2. Coulson,J.M. and J.F. Richardson, Chemical Engineering, Volume I to V. The Pergamon Press, New York, 1999

21AG504 IOT IN AGRICULTURAL SYSTEMS 3 0 2 4

Course Objectives

- To know the operation of various electronic circuits and its applications.
- To get adequate knowledge about various sensors used in agriculture processes
- To learn optimization techniques and e-governance in agricultural system

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Course Outcomes (COs)

1.Execute the working operations of electronic devices and processors

2.Implement the necessity of sensor requirements to analyse the soil parameters required for the field

3.Implement various on-line measurement of plant growth and management of crop growth in green houses using various sensors

4.Assess the basic statistical tools and optimization technique that can be used to analyse the data collected in modern agriculture business

5.Implement the concept of Information Technology in governing the agricultural systems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1	1	1	2	2					2		
2	3	2	3	1	1	2	3					2		
3	2	3	3	2	3	2	3					2		
4	2	3	3	2	3	2	3					2		
5	2	3	3	2	2	2	3					2		

UNIT I **9 Hours**

BASIC ELECTRONICS CIRCUITS

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 **9 Hours**

PRECISION FARMING

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

UNIT III **9 Hours**

ENVIRONMENT CONTROL SYSTEM

Artificial light systems, management of crop growth in greenhouses, simulation of CO2 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 **9 Hours**

AGRICULTURAL SYSTEMS MANAGEMENT

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 **9 Hours**

E-G OVERNANCE IN AGRICULTURAL SYSTEMS

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.

1 **4 Hours**

EXPERIMENT 1

Design an automatic control of water pump in the agricultural field based on soil moisture content

2 **4 Hours**

EXPERIMENT 2

Implement the smart agricultural system to control soil pH and NPK parameters by using IOT

3 **4 Hours**

EXPERIMENT 3

Design a control system for greenhouse environment and monitor the parameters on Android application

4 **4 Hours**

EXPERIMENT 4

Design an IOT based hydroponic system with artificial LED light for smart home farming of lettuce

5

4 Hours

EXPERIMENT 5

Demonstrate an IOT based weather monitoring and reporting system for specific location using Think Speak app

6 **4 Hours**

EXPERIMENT 6

Implement an IOT based self-tracking solar powered irrigation system

7 **4 Hours**

EXPERIMENT 7

Design a drone system for automatic spraying of pesticide in the agricultural field

8 **4 Hours**

EXPERIMENT 8

Design an autonomous disease identification robot that drives around greenhouse environment by using raspberry Pi camera system

Reference(s) **Total: 75 Hours**

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.

21AG507 FARM IMPLEMENTS AND EQUIPMENT LABORATORY 0 0 2 1

Course Objectives

- To learn about the tools and techniques used for a wide variety of different types of farming operations and landscaping
- To utilize the power tools and mounted implements with the tractor
- To develop skills on safe and efficient use of tractors and power tillers

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Execute the power tools and mounted implements with the tractor
2. Assess skills on safe and efficient use of tractors and power tillers
3. Select the tools and techniques used for a wide variety of different types of farming operations and landscaping
4. Plan an Agro Service Centre for Farm Machinery
5. Choose the seed planter and centrifugal broadcasting device in the field

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1	2			1							
2	1	3	1	2	-		1							
3	1	3	1		2		1							
4	1	3	1		2		1				-	1		
4	1	3	1		2		1				-	1		

1 **2 Hours**

EXPERIMENT 1

Operation of an animal drawn plough, measuring the draft

2 **2 Hours**

EXPERIMENT 2

Operation of a tractor drawn mould board plough - adjustments – determination of field capacity

3 **2 Hours**

EXPERIMENT 3

Operation of a tractor drawn disc plough - adjustments - determination of field capacity

4 **2 Hours**

EXPERIMENT 4

Hitching of mounted implements to the tractor and ploughing with mounted implements

5 **2 Hours**

EXPERIMENT 5

Operation of tractor drawn cultivator - adjustments- and determination of field capacity

6 **2 Hours**

EXPERIMENT 6

Operation of a subsoiler - adjustments - determination of field capacity

7 **2 Hours**

EXPERIMENT 7

Experiment on Calibration of seed drills

8 **2 Hours**

EXPERIMENT 8

Operation of seed planter and centrifugal broadcasting device in the field

9 **2 Hours**

EXPERIMENT 9

Operation of paddy transplanter and drum seeder in the field and determination of field capacity

10 **2 Hours**

EXPERIMENT 10

Study of wetland implements - puddlers and tramplers

11 **2 Hours**

EXPERIMENT 11

Operation and evaluation of dry land weeders and power operated weeder

12 **2 Hours**

EXPERIMENT 12

Dismantling, parts identification and assembly of different components of knapsack power sprayer and duster.

13 **2 Hours**

EXPERIMENT 13

Field-testing of rocker arm sprayer, power sprayer and boom sprayer and their

14 **2 Hours**

EXPERIMENT 14

Study of different types of nozzles and analysis of spray pattern

15 **2 Hours**

EXPERIMENT 15

Determination of operational cost of farm implements

Total: 30 Hours

Reference(s)

1. Lal, Radhey and Dutta, A.C. Agricultural Engineering through solved examples, Saroj Prakashan Publishers, Allahabad, 1971

2. Krutz, Gary, Thompson Lester and Claar, Paul, Design of Agricultural Machinery", John Wiley and Sons, 1984

21AG508 UNIT OPERATIONS IN AGRICULTURAL PROCESS ENGINEERING LABORATORY **0 0 2 1**

Course Objectives

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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Execute the evaporation process and types of evaporators for food industry
2. Analyze the principles of filtration and mechanical separation equipment
3. Implement the gas-liquid and solid-liquid equilibrium concepts and factors influencing equilibrium separation process.
4. Differentiate crystallization and distillation processes and identify processing equipment.
5. Differentiate performance evaluation of a steam distillation process.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2											
2	2	1												
3	2	2	2	2										
4	2	2												
5	2	2	2	2										

1 **2 Hours**

EXPERIMENT 1

Determination of thermal efficiency and economy of evaporator

2 **2 Hours**

EXPERIMENT 2

Problems on single effect and multiple effect evaporators

3 **2 Hours**

EXPERIMENT 3

Determination of separation efficiency of centrifugal separator

4 **2 Hours**

EXPERIMENT 4
Determination of collection efficiency in cyclone separator

5 **2 Hours**

EXPERIMENT 5
Determination of efficiency of liquid-solid separation by filtration

6 **2 Hours**

EXPERIMENT 6
Determination of absorption efficiency in a packing tower

7 **2 Hours**

EXPERIMENT 7
Performance evaluation of a sieve and determination of particle size of granular foods by sieve analysis

8 **2 Hours**

EXPERIMENT 8
Determination of energy requirement in size reduction using the burr mill

9 **2 Hours**

EXPERIMENT 9
Determination of energy requirement in size reduction using the ball mill and hammer mill

10 **2 Hours**

EXPERIMENT 10
Determination of mixing index for solids

11 **2 Hours**

EXPERIMENT 11
Determination of economy and thermal efficiency of rotary flash evaporator for concentration of juice

12 **2 Hours**

EXPERIMENT 12
Performance evaluation of a steam distillation process

13 **2 Hours**

EXPERIMENT 13
Visit to a solvent extraction industry

14 **2 Hours**

EXPERIMENT 14
Visit to a membrane separation based industry

15 **2 Hours**

EXPERIMENT 15
Visit to a sugar industry

Total: 30 Hours

0 0 2 0

21GE501 SOFT SKILLS - APTITUDE I

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Course Outcomes (COs)

1. Execute various concepts of number systems and their techniques in solving the percentage, average and age problems.
2. Analyse the profit and loss of real time situations and the relation between ratio, proportion and variation.
3. Apply different techniques to find the distance, speed and time of various moving objects.
4. Assess the concepts of coding, sequences and series, data interpretation and critical reasoning to solve real time logical reasoning problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2	1													
3	1													
4	1													
5	1													

1

NUMBER SYSTEMS

Introduction - Definition - Classification on Numbers- Power cycles and remainders - Short cut process- Concept of Highest Common Factor-Concept of Least Common Multiple- Divisibility- Number of zeros in an expression.

2

PERCENTAGE

Introduction - Definition and Utility of Percentage - Importance of base/denominator for percentage calculations-Concept of percentage values through additions-Fraction to percentage conversion table.

3

AVERAGES AND AGES

Introduction-Average of different groups-Addition or removal of items and change in average-Replacement of some of the items.

4

RATIO, PROPORTIONS AND VARIATION

Introduction- Ratio- Properties-Dividing a given number in the given ratio-Comparison of ratios-Proportions-Useful results on proportion- Continued proportion-Relation among the quantities more than two-Variation.

5

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-Multiplying equivalents to find sale price-Relation among cost price, sale price, gain/loss and percentage gain or percentage loss-An article sold at two different selling price-Two different articles sold at same selling price-Percentage gain or percentage loss on selling price-Percentage gain or percentage loss on whole property.

6

TIME AND WORK

Introduction-Basic concepts-Concepts on working with different efficiencies-Pipes and Cisterns-Work Equivalence (Man Days) -Alternative approach.

7

TIME, SPEED AND DISTANCE

Definition-Basics of Time, Speed and Distance - Relative speed-Problems based on Trains-Problems based on Boats and Streams-Problems based on Races-Time taken with two difference modes of transport-Time and distance between two moving bodies.

8

CODING AND DECODING

Introduction-Description of Coding method-Coding patterns - Concepts of Coding and Decoding-Problems involving Coding and Decoding methods.

9

SEQUENCE AND SERIES

Introduction-Sequences of real numbers - Number and Alphabet series-Description of Number and Alphabet series-Analogy-Odd man out-Power series.

10

DATA SUFFICIENCY

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid.

11

DIRECTION

Introduction to Direction - sense test - Overview of the wide variety of Direction problems-Direction-Plotting diagrams.

12

CRITICAL REASONING

Introduction-Basic concept of critical reasoning- Weaken the argument-Strengthen the argument-Flaw in the argument-Evaluate the conclusion.

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.

2. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.

3. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.

4. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth

Edition, Mc Graw Hill Publications.

5. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

21HS002 HUMAN VALUES AND ETHICS 2 0 0 2

Course Objectives:

- 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
- To 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
- To 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

Programme Outcomes (POs)

h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1.The students start exploring themselves; get comfortable to each other and to the teacher and start finding the need and relevance for the course
The students can see that verification on the basis of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity; it will only develop assumptions
2.The students become aware of their activities of 'I' and start finding their focus of attention at different moments. Also, they are able to see that most of their desires are coming from outside (through preconditioning or sensation) and are not based on their natural acceptance.
3.The students are able to see that respect is right evaluation, and only right evaluation leads to fulfilment in relationship
4. The students feel confident that they can understand the whole existence; nothing is a mystery in this existence. They are also able to see the interconnectedness in the nature and point out how different courses of study relate to the different units and levels. Also, they are able to make out how these courses can be made appropriate and holistic.
5.The students can present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								3						
2								3						
3								3						
4								3						
5								3						

UNIT I **6 Hours**

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

1.Importance of Human Values & Ethics in 21st Century
2.Understanding the theory of basic human values and ethics
Openness to change
Self-enhancement Conservation
Self-transcendence
3. Schwartz Value Survey: Self-Assessment

UNIT II **6 Hours**

EMBRACING THE COMMON ETIQUETTE

Altruism – Integrity -Freedom -Justice -Honesty -Truthfulness -Responsibility –Compassion

UNIT III **6 Hours**

CONTINUOUS HAPPINESS AND PROSPERITY

An overview on basic Human Aspirations - Understanding and living in harmony at various levels of life - Embracing self-love and wellness -Understanding harmony in the family and society

UNIT IV **6 Hours**

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Reflection on growing global multifold problems: poverty, pollution, hunger, disease, unemployment, caste system, child labour, gender equality, politics and violence.
Understanding the challenges in cultural, personal, social, political, and economic environment

UNIT V **6 Hours**

UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE

Understanding the harmony in the Nature - Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions

Total: 30 Hours

Reference(s)

1. Martin, G. (2011). The Little Book of Ethics: A Human Values Approach. Australia: G.P. Martin.
2. Gupta, N. L. (2002). Human Values For The 21St Century. India: Anmol Publications Pvt. Limited.
3. Mishra, A. (2017). Happiness Is All We Want. India: Bloomsbury Publishing.
4. Universal Human Values. (2023). (n.p.): Booksclinic Publishing.
5. A Textbook On Professional Ethics And Human Values. (2007). India: New Age International (P) Limited

21AG602 IRRIGATION AND DRAINAGE ENGINEERING 3 0 0 3

Course Objectives

To acquire a fundamental understanding of different irrigation methods
To learn about the importance of drainage in crop production and the need to control water logging and salinization
To develop skills on design of different irrigation and drainage systems
To gain the knowledge on management of irrigation and drainage systems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
n. To improvise better ways to minimize the crop loss from field damage during post-harvest management and energy utilization, sorting, processing and packaging.

Course Outcomes (COs)

1.Execute the development and utilization of water resources in India as well as Tamil Nadu and estimate the evapo-transpiration using direct and indirect methods for scheduling the irrigation for various crops

2.Determine irrigation requirements of crops and plan the irrigation schedule for different crops including irrigation efficiencies.

3. Design different methods of surface irrigation and their adaptability to the specific characteristics of soil, topography and crops

4.Execute the command area development works including on farm development works, maintenance and its economics and water distribution system like warabhandhi and rotational waters supply system

5.Design, monitor and maintain the surface and sub surface drainage systems for controlling the salinity and water logging in the agricultural area.

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Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2	2	1	1						1		2
2	2	3	2	2	1	1						1		1
3	1	2	3	2	2									1
4	2	2	3	1		-						2		1
5	2	1	3	2	-							1		

UNIT 1 **9 Hours**

IRRIGATION WATER AND ITS MEASUREMENT

Irrigation, impact of irrigation on Human Environment, some major and medium irrigation schemes of India, purpose of irrigation, sources of irrigation water, present status of development and utilization of different water resources of the country, Measurement of irrigation water, weir, notches, flumes and orifices and other methods, Economics of water resources utilization.

UNIT 2 **8 Hours**

IRRIGATION REQUIREMENT

soil water plant relationship, soil water movement, infiltration, evapotranspiration, soil moisture constants, depth of irrigation, frequency of irrigation, water conveyance , underground pipe conveyance system, channel lining, irrigation efficiencies.

UNIT 3 **9 Hours**

METHODS OF IRRIGATION

Surface irrigation methods of water application, border, check basin, furrow and contour irrigation;
sprinkler and drip irrigation method, merits, demerits, selection and design.

UNIT 4 **10 Hours**

AGRICULTURAL DRAINAGE SYSTEM

Drainage, objectives of drainage, familiarization with the drainage problems of the state, Surface drainage, drainage coefficient, types of surface drainage, design of open channel, sub-surface drainage purpose and benefits, investigations of design parameters, hydraulic conductivity, drainable porosity, water table etc., types and use of subsurface drainage system, Design of surface drains, interceptor and relief drains. Derivation of ellipse (Hooghoudt's) and Ernst's drain spacing equations.

UNIT 5 **9 Hours**

DESIGN OF AGRICULTURAL DRAINAGE SYSTEM AND SALT BALANCE

Design of subsurface drainage system. Drainage materials, drainage pipes, drain envelope. Layout, construction and installation of drains. Drainage structures. Vertical drainage. Bio-drainage. Tile Drains. Drainage of irrigated and humid areas. Salt balance, reclamation of saline and alkaline soils. Leaching requirements, conjunctive use of fresh and saline waters. Economic aspects of drainage.

FOR FURTHER READING

GIS- concept-use of GIS for identifying the areas that need drainage-design of drainage systems based on the data obtained through remote sensing from satellites.

Total: 75 Hours

Reference(s)

1. A.M.Michael, 2010. Irrigation - Theory and practice, Vikas publishers, New Delhi.
2. V. Ravikumar., M.V.Ranghaswami, K.Appavu and S.Chellamuthu, 2011, Microirrigation& Irrigation Pumps, Kalyani publishers, Ludhiana
3. Michael Raviv and J.Heinrich Lieth. ,2013, Soil less culture, Theory and Practice, Elsevier
4. Jack Keller and Rond Bleisner 1990. Sprinkler and Trickle irrigation, Van Nostrand Reinhold, New York.
5. P.N Modi, and S.M Seth, 2010, Hydraulics and fluid mechanics, Standard book house

21AG603 POST HARVEST TECHNOLOGY OF AGRICULTURAL CROPS 3 0 0 3

Course Objectives

To understand better the processing of cereals, pulses, oil seeds and horticultural crops
To know the physical and thermal properties of grains
To understand in-depth knowledge on the theory, methods, and equipment for the various unit operations of crop processing

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
n. To improvise better ways to minimize the crop loss from field damage during post-harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Execute better exposure to the different engineering properties of biological materials and their importance
2. Implement the working principles of grain cleaning and grading devices and able to select suitable equipment for cereal grains, oilseeds, and pulses
3. Find conveying and storage systems used for agricultural products and apply knowledge on properties of product to identify systems for the better processing
4. Apply the knowledge on the various properties of the cereals, pulses, and oil seeds for processing
5. Find post-harvest operations for horticultural crops utilize the skills on post- harvest machines to increase the market value of the processed food products

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	2	1	2								2
2	2	3	2	2	2	1	1							1
3	2	3	3	2	1	1								1
4	2	2	3	2	1	1	1					1		
5	2	1	3	2	2	1	1					1		

UNIT I **8 Hours**

INTRODUCTION

Post-harvest engineering: introduction, objectives, post-harvest losses of cereals, pulses and oilseeds, importance, optimum stage of harvest. Threshing: traditional methods, mechanical threshers: types, principles and operation. Engineering properties of food materials, moisture content measurement: direct and indirect methods, moisture meters, equilibrium moisture content

UNIT II **10 Hours**

CLEANING, GRADING AND DRYING

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. Drying: moisture content and water activity; Free, bound and equilibrium moisture content, isotherm, hysteresis effect, EMC determination, Drying principles and theory, Thin layer and deep bed drying analysis, Falling rate and constant rate drying periods, maximum and decreasing drying rate period, drying equations, Dryer performance, Different methods of drying, types of grain dryers: dryers: bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray

UNIT III **9 Hours**

MATERIAL HANDLING AND STORAGE

Material handling: belt conveyor, screw conveyor, chain conveyor, bucket elevators, pneumatic conveying. Direct and indirect types of damages, sources of infestation, traditional and modern types of storage structures: vertical, horizontal and underground storages, storage structure designs. Hermetic storage, Controlled atmospheric storage and modified atmospheric storage.

UNIT IV **9 Hours**

PROCESSING OF CEREALS, PULSES AND OILSEEDS

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, performance evaluation of modern mills. Wheat milling, pulse milling methods. Oil seed processing, Sugarcane crushing, extraction recovery and processing of jaggery. Principles and operation: maize sheller, husker sheller for

maize, groundnut decorticator, castor sheller.

UNIT V **9 Hours**

PROCESSING OF FRUITS AND VEGETABLES

Importance of processing of fruits and vegetables. Important characteristics and properties of fruits and vegetables for processing, cleaning and grading of fruits and vegetables. Electronic colour sorting of fruits and vegetables. Unit operation of fruit processing: blanching of fruits and vegetables, size reduction, thermal processing. Dryers for fruits and vegetables, Osmo -dehydration. Different types of packaging materials commonly used for raw and processed fruits and vegetables products, handling and transportation of fruits and vegetables, Minimal processing, Common methods of storage. Preparation of different finished products from fruits and vegetables.

FOR FURTHER READING

Project preparation - Solar drying of grains-agro processing industries – Value added products from agricultural products- By-products utilization.

Total: 45 Hours

Reference(s)

1. N.N. Mohsenin, Physical Properties of Plant And Animal Materials, Gordon and Breach publishers, New York, 1986
2. W.L. McCabe and J.C. Smith, Unit Operations in Chemical Engineering, McGraw Hill Kogakusha Ltd, Tokyo, 2001

21AG607 IRRIGATION ENGINEERING LABORATORY 0 0 2 1

Course Objectives

- To acquire a fundamental understanding of different irrigation methods
- To learn about the importance of drainage in crop production and the need to control water logging and salinization
- To develop skills on design of different irrigation and drainage systems
- To gain the knowledge on management of irrigation and drainage systems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Design and construct irrigation structures
2. Possess a good understanding of the factors related to drainage, essential to design, construct and manage a drainage system.
3. Design, monitor and maintain drainage systems
4. Determine water requirements of crops and the irrigation schedule for different crops

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	2	1									
2	2	3	1	2	2									
3	2	2	3	2	1									
4	3	2	2	1								1		

1 **2 Hours**

EXPERIMENT 1

Study of River basins, irrigation projects, irrigation tanks and water resources in Tamil Nadu.

2 **2 Hours**

EXPERIMENT 2
Determination of soil moisture by different methods -gravimetric and tensiometer, block and neutron probe method.

3 **2 Hours**

EXPERIMENT 3
Problems on duty of water - Duty and delta relationship

2 Hours

4

EXPERIMENT 4
Estimation of water requirement by different methods

5 **2 Hours**

EXPERIMENT 5
Estimation of Evapotranspiration

6 **2 Hours**

EXPERIMENT 6
Land Levelling Plane method from climatologically data

7 **2 Hours**

EXPERIMENT 7
Determination of irrigation efficiencies and design of basin and furrow irrigation systems

8 **2 Hours**

EXPERIMENT 8
Problems on irrigation efficiencies and design of border irrigation systems

9 **2 Hours**

EXPERIMENT 9
Design of Basin and Furrow irrigation Ã¢?? Problems

10 **2 Hours**

EXPERIMENT 10
Design of underground pipeline system

11 **2 Hours**

EXPERIMENT 11
Problems on Irrigation scheduling

12 **2 Hours**

EXPERIMENT 12
OFD works in command areas

13 **2 Hours**

EXPERIMENT 13

Design of surface and sub-surface drainage systems.

14 **2 Hours**

EXPERIMENT 14

Field visit to command areas and observation of OFD works

15 **2 Hours**

EXPERIMENT 15

Measurement of water flow using V- notch, rectangular notch, circular notch and parshall flume

Total: 30 Hours

Reference(s)

1. Dilip Kumar Majumdar, Irrigation water Management-Principles and Practice, Prentice-Hall of India Pvt. Ltd, New Delhi, 2006
2. A.M. Michael, Irrigation -Theory and Practice, Vikas publishing house, New Delhi, 1990.
3. V.V.N. Murthy, Land and water management, Kalyani publishing, New Delhi, 1998.

21AG608 POST HARVEST TECHNOLOGY OF AGRICULTURAL CROPS LABORATORY

0 0 2 1

Course Objectives

- To understand better the processing of cereals, pulses, oil seeds and horticultural crops
- To know the physical and thermal properties of grains
- To understand in-depth knowledge on the theory, methods, and equipment for the various unit operations of crop processing

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Determine the different engineering properties of biological materials and their importance
2. Design different post harvest equipment for cereals and oil seeds
3. Determine the efficiency of various grain cleaning and milling equipment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	2	1	1	1					1		
2	3	2	2	2	1	1						1		
3	3	2	2	2	1	1						1		

1 **2 Hours**

EXPERIMENT 1
Determination of moisture content of grains, potato slice by oven-dry method and draw the drying characteristic curves

2 **2 Hours**

EXPERIMENT 2
Determination of size, true density, bulk density and porosity of grains

3 **2 Hours**

EXPERIMENT 3
Determination of coefficient of friction internal

4 **2 Hours**

EXPERIMENT 4
Determination of angle of repose of different grains

5 **2 Hours**

EXPERIMENT 5
Determination of milling quality of different grains

6 **2 Hours**

EXPERIMENT 6
Determination of shelling efficiency of groundnut decorticator

7 **2 Hours**

EXPERIMENT 7
Evaluation of thermal efficiency and heat utilization factor in a grain drier

8 **2 Hours**

EXPERIMENT 8
Determination of drying characteristics of grains

9 **2 Hours**

EXPERIMENT 9
Visit to a processing industry to study bucket elevator and screw conveyor

10 **2 Hours**

EXPERIMENT 10
Performance evaluation of paddy parboiling drum

11 **2 Hours**

EXPERIMENT 11
Evaluation of efficiency of a grain cleaning cum grading machine

12 **2 Hours**

EXPERIMENT 12

Evaluation of shelling efficiency of rubber roll sheller and cone polisher

13 **2 Hours**

EXPERIMENT 13

Determining the oil content of oil seeds using Soxhlet apparatus

14 **2 Hours**

EXPERIMENT 14

Determination of drying characteristics of fruits and vegetables

15 **2 Hours**

EXPERIMENT 15

Visit to modern rice mill/ pulse/ oil milling industries

Reference(s)

1. W.L. McCabe and J.C. Smith, Unit Operations in Chemical Engineering, McGraw Hill Kogakusha Ltd, Tokyo, 2001

21AG701 RS AND GIS FOR NATURAL RESOURCE MANAGEMENT 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post-harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

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

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-		3			1					1	1	
2	2	-	-	3			1							
3	1	-	2	3			2							2
4		-	-	3									3	
5	-			3		-						2	1	

UNIT I **6 Hours**

BASICS OF REMOTE SENSING

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. Types of platforms - orbit types, Sun-synchronous and Geosynchronous - Passive and Active sensors. Indian Space Programme, Sensor characteristics LANDSAT, SPOT, ERS, IKONOS, IRS and others.

UNIT II **6 Hours**

IMAGE INTERPRETATION AND ANALYSIS

Types of Data Products - types of image interpretation - basic elements of image interpretation -visual interpretation keys - Digital Image Processing - Preprocessing - image enhancement techniques - multi-spectral image classification - Supervised and unsupervised.

UNIT III **6 Hours**

GEOGRAPHIC INFORMATION SYSTEM

Introduction to Maps - Definitions - Basic components of GIS – Map projections and co-ordinate system – Spatial data structure: raster, vector – Spatial Relationship – Topology – Geodatabase models: hierarchical, network, relational, object oriented models – Data Encoding methods – encoding raster data, vector data and attribute data, linking spatial and attribute data- Integrated GIS database - Digital Elevation Modelling

UNIT IV **6 Hours**

GEOSPATIAL ANALYSIS

Thematic mapping – Geospatial Measurements, query analysis, buffering, overlay operations, network analysis, DEM, DSM, DTM, Interpolation - Geovisualisation - Object oriented GIS – Modern trends of GIS – WebGIS, 3DGIS, Real-time GIS.

UNIT V **6 Hours**

RS AND GIS APPLICATIONS

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 - Water quality modeling - Drought monitoring – Cropping pattern change analysis. Application of Remote Sensing and GIS in Precision Agriculture - Monitor Crop Health.

FOR FURTHER READING

Microwave remote sensing SAR Technology and their application in Agriculture and Soils, forestry, hydrology and disaster management

Total: 30 Hours

EXPERIMENTS

1 **2 Hours**

EXPERIMENT 1
Aerial and Satellite images interpretation - visual

2 **2 Hours**

EXPERIMENT 2
Supervised classification practice

3 **2 Hours**

EXPERIMENT 3
Unsupervised classification practice

4 **2 Hours**

EXPERIMENT 4
Spatial data input and editing- Digitizing

5 **2 Hours**

EXPERIMENT 5
Raster analysis problems - Database query

6 **2 Hours**

EXPERIMENT 6
GIS applications in DEM and its analysis

7 **2 Hours**

EXPERIMENT 7
GIS application in watershed analysis

8 **2 Hours**

EXPERIMENT 8
GIS application in rainfall-runoff modeling

Total: 60 Hours

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. Basudeb Bhatta, Remote Sensing and GIS, II Edition, Oxford University Press, New Delhi, 2011

5. Floyd F.Sabins, Remote Sensing: Principles and Interpretation, III edition, Freeman and Company, New York, 1997

6. M.Anji Reddy, Textbook of Remote Sensing and Geographical Information System, 3rd Edition, BS Publications, 2008

21AG702 RENEWABLE ENERGY RESOURCES 3 0 2 4

Course Objectives

- To acquire knowledge about the fundamentals of renewable energy resources.
- To understand the concepts and conversion systems in harnessing.
- To apply the above concepts in meeting the energy needs in farm

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Organize the energy scenario and status of renewable energy sources and production in India
2. Execute the knowledge on thermal conversion technologies
3. Execute the knowledge on biochemical conversion technology and biofuels
4. Find the way to use solar energy conversion system (secs) and wind energy conversion system (wecs) to meet the energy requirements of farms
5. Execute the knowledge on hydro and ocean energy conversion system and energy auditing

ArticulationMatrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-			3	1	2							2
2	1	3	-	2	2		2							
3	1	2	3	1	1		1							1
4	1	3	2	2	1		2							
5	1	2	3	1	1		2							1

UNIT I **9 Hours**

OVERVIEW OF RENEWABLE ENERGY SOURCES

Classification of energy sources, Renewable Energy-Potentials and Achievements. Characterization of biomass, Densification of biomass - Briqquetting

UNIT II **9 Hours**

THERMOCHEMICAL CONVERSION TECHNOLOGY (TCCT)

Biomass Combustion Technology, Gasifiers Technology, Biomass Gasification Methods, Removal of tar and impurities from gasification, Principles of pyrolysis and methods.

UNIT III **9 Hours**

BIOCHEMICAL CONVERSION TECHNOLOGY-BIOGAS (BCCT) AND BIO FUELS

Importance of biofuels, Biogas technology, Biogas plants types, Microbiology of biogas production, Size and selection for Biogas plant, Biogas plant- materials and methods for Construction. Bio-Fuels and characteristics, Bio-Diesel, Bio-Diesel production processes, Bio-Ethanol Production, BEA, running of biofuel engines.

UNIT IV **9 Hours**

SOLAR ENERGY CONVERSION SYSTEM (SECS) AND WIND ENERGY CONVERSION SYSTEM (WECS)

Basics of Solar Photovoltaics, Recent trends in solar drying-solar tunnel drier, Solar Driers, Solar PV and water pumping, Solar Water Heater. Wind energy conversion principles, Wind mill- aero generator, Wind mill- water pumping.

UNIT V **9 Hours**

HYDRO AND OCEAN ENERGY CONVERSION SYSTEM AND ENERGY AUDITING

Hydropower Energy Sources. Hydropower types sustainabiity. Ocean Energy conversion systems, Ocean Thermal Energy Conversion (OTEC) system- thermodynamic efficiency- cycle typesenvironmental effect-technical difficulties. Energy Auditing- carbon foot print. Clean development mechanism

FOR FURTHER READING

Energy Auditing and Management.

1 **2 Hours**

EXPERIMENT 1

Problems on solar time, basic earth sun angles

2 **2 Hours**

EXPERIMENT 2

Study of radiation measuring instruments - Visit to meteorology station

3 **2 Hours**

EXPERIMENT 3

Solving problems on thermal losses and efficiency of flat plate collectors

4 **2 Hours**

EXPERIMENT 4

Determination of thermal efficiency of solar water heater

5 **2 Hours**

EXPERIMENT 5
Determination of thermal efficiency of natural convection solar dryer

6 **2 Hours**

EXPERIMENT 6
Determination of thermal efficiency of forced convection solar dryer

7 **2 Hours**

EXPERIMENT 7
Determination of thermal efficiency of solar still

8 **2 Hours**

EXPERIMENT 8
Study of photovoltaic cell characteristics

9 **2 Hours**

EXPERIMENT 9
Study on the performance of wind generator in the lab

10 **2 Hours**

EXPERIMENT 10
Performance evaluation of a SPV water pumping system

11 **2 Hours**

EXPERIMENT 11
Wind Energy conversion calculations for power generation

12 **2 Hours**

EXPERIMENT 12
Design of rotor blade for horizontal axis wind mill

13 **2 Hours**

EXPERIMENT 13
Study of wind measuring instruments

14 **2 Hours**

EXPERIMENT 14
Visit to a solar PV power plant

15 **2 Hours**

EXPERIMENT 15
Experiment on duel fuel engine

Total: 75 Hours

Reference(s)

1. H. P. Garg, Treatise on Solar Energy, Vol.1 : Fundamentals of solar energy, John Wiley & sons Ltd, 1982.
2. A.John. Duffie and William A. Beckman, Solar Engineering of Thermal Processes, 4th Edition ISBN: 978-0-470-87366-3, John Wiley and Sons Ltd, 2013
3. Jui Sheng Hsieh, Solar Energy Engineering, Prentice Hall, London,
4. H.P. Garg, Advances in Solar Energy Technology Volume 2, Industrial Applications of Solar Energy, ISBN: 978-94-010-8188-7 (Print), Springer Publications. 1987.
5. Solanki Chetan Singh, Solar Photovoltaics: Fundamentals, Technologies and Applications, Prentice-Hall Of India Pvt. Limited, 2009
6. J.F.Manwell, J.G. McGswan and A.L.Rogers, Wind Energy Explained. Theory, Design and Application, John Wiley and Sons Ltd, 2004

21AG707 PROJECT WORK I 0 0 6 3

Course Objectives

- To develop knowledge to formulate a real world problem and project goals
- To identify the various tasks of the project to determine standard procedures
- To understand the guideline to prepare report for oral demonstration

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Execute a real world problem, identify the requirement and develop the design solutions
2. Find technical ideas, strategies and methodologies
3. Assess the new tools, algorithms, techniques that contribute to obtain the solution of the project
4. Resolve through conformance of the developed prototype and analysis the cost effectiveness
5. Produce report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	3	2			2	1						3	1
2	2	2	1	3		2					2	2	2	
3			3	2	2			2			2	2	3	
4		1		2	3	1	2	2					1	3
5									3	3	-	2		3

21AG801 PROJECT WORK II 0 0 18 9

Course Objectives

- To develop knowledge to formulate a real world problem and project goals
- To identify the various tasks of the project to determine standard procedures
- To understand the guideline to prepare report for oral demonstration

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Execute a real-world problem, identify the requirement and develop the design solutions
2. Find technical ideas, strategies and methodologies
3. Assess the new tools, algorithms, techniques that contribute to obtain the solution of the project
4. Resolve through conformance of the developed prototype and analysis the cost effectiveness
5. Produce report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	3	2			2	1						3	1
2	2	2	1	3		2					2	2	2	
3			3	2	2			2			2	2	3	
4		1		2	3	1	2	2					1	3
5									3	3	-	2		3

21HSF01 FRENCH 1 0 2 2

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

Course Outcomes (COs)

1. To help students acquire familiarity in the French alphabet & basic vocabulary
2. listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue francaise, alphabets, les numeros, les jours, les mois. Grammaire Les verbes s"appeler,etre, avoir, les articles definis, indefinis Communication - Saluer, s"informer sur quelquun, demander de se presenter Lexique - Les alphabets, les nationalites, age, les pays, les couleurs, les jours de la semaine, les mois de l"annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites Grammaire - Verbes - Conjugaison : Present (Avoir / etre / ER, IR, RE : Regulier et Irregulier) – Adjectifs les propositions de lieu Communication - Chercher un logement, d"ecrire son voisin, s"informer sur unlogement Lexique - L"habitat, les pieces, l"equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN

Grammaire - Articles contractes, verbes vouloir, pouvoir, devoir, adjective interrogative, future proche Communication- Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie Lexique - le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT LA CULTURE

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l''imparfait Communication - Propose a quelqu""un de faire quelque chose, raconteur une sortie au passe parler unfilm Lexique - Les sorties, la famille, art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite Communication Accepter et refuse rune invitation, donner des instructions, commander au restaurant Lexique Les services et les commerces, les aliments, les ustensiles, argent

Total: 45 Hours

Reference(s)

1. Saison A1, Methode de francais
2. Hachette FLE

21HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Read and understand ideas of complex text on both concrete and abstract topics
- Listen and understand technical discussions in his/her field of specialisation
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Vantage exam level.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic
3. Write simple reports of factual nature and factual non-routine letters
4. Ask for factual information and understand the answer; and take/pass on workplace messages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2									2					
3									3					
4	2									1				
5	2									2				

UNIT I **9 Hours**

GRAMMAR3

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II **9 Hours**

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III **9 Hours**

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarizing - proposal: describing, summarising, recommending, persuading.

UNIT IV **9 Hours**

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V **9 Hours**

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision- aking. 1. A Horse and Two Goats - R K Narayan 2.My Lord the Baby - Rabindranath Tagore 3.Twist in the Tale - Jeffery Archer.4.The Third and Final Continent - Jhumpa Lahiri 5.The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.

2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014

3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.

4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

21HSC01 CHINESE 1 0 2 2

Course Objectives

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various situations

Programme Outcomes (POs)

A. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen and identify individual sounds of Chinese
2. Use basic sounds and words while speaking
3. Read and understand short passages on familiar topics
4. Use basic sentence structures while writing
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

Hello 1.Initials and Finals of Chinese b,p,m,f,d,,n,l,g,k,h,j ,q,x 2. Tones Four 3.Chinese Syllables 4.Tone S

UNIT II **9 Hours**

Thank you - Initials and Finals of Chinese The Neutral Tone Rules of Tone Marking and Abbreviation

UNIT III **9 Hours**

1. What"s your name - In the school; -In the classroom; -In the school The Interrogative Pronoun 2 The Sentence. 3 Interrogative Sentences with

UNIT IV **9 Hours**

She is my Chinese teacher In the library. The Interrogative Pronouns. The Structural Particle The interrogative Particle

UNIT V **9 Hours**

Her daughter is 20 years old this year -
1.The Interrogative Pronoun. 2. Numbers below 100. 3.Indicating a Change. The Interrogative Phrase

Total: 45 Hours

21HSG01 GERMAN 1 0 2 2

Programme Outcomes (POs)

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen and identify individual sounds of German
2. Use basic sounds and words while speaking
3. Read and understand short passages on familiar topics
4. Use basic sentence structures while writing
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

UNIT 1

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

UNIT II **9 Hours**

UNIT 2

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

UNIT III **9 Hours**

UNIT 3

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

UNIT IV **9 Hours**

UNIT 4

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

UNIT V **9 Hours**

UNIT 5

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, Netzwerk A1 Deutsch Als Fremdsprache, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015

2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009

3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

21HSH01 HINDI 1 0 2 2

Course Objective

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day-to-daysituations
- To help students acquire the ability to understand a simple technical text inHindi

Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day-to-dayconversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				

UNIT I **9 Hours**

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions.

UNIT V **9 Hours**

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar SabhaChennai
2. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People,Vee Kumar Publications(P)Ltd., New Delhi,2009
3. Videos, Stories, Rhymes and Songs

21HSJ01 JAPANESE 1 0 2 2

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-dayconversation
- To make students familiar with the Japanese cultural facets and social etiquettes

Course Outcomes (COs)

1. Recognise and write Japanese alphabet
2. Speak using basic sounds of the Japaneselanguage
3. Apply appropriate vocabulary needed for simple conversation in Japaneselanguage
4. Apply appropriate grammar to write and speak in Japaneselanguage
5. Comprehend the conversation and give correct meaning

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										3				
2										1				
3										2				
4										2				
5										3				

UNIT I **9 Hours**

Introduction to Japanese - Japanese script- Pronunciation of Japanese(Hiragana)- (Katakana) Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do (Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers)

UNIT II **9 Hours**

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vechile) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers).

UNIT III **9 Hours**

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N -

Vocabulary (30 Numbers)

UNIT IV **9 Hours**

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT V **9 Hours**

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

Total: 45 Hours

Text Book(s)

1. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Reference(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

21GE0P1 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Outcomes (COs)

1. Summarize the origin **Course** and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	2	2												
3	3	1												
4	1	1												
5	2	3												

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties - differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LED: basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- particulate and geometrical nanomagnets-magneto resistance.

Total: 45 Hours

Reference(s) r

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012

2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007

3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.

4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012

5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006

6. Viswanathan B, Aulice Scibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

21GE0P2 **SEMICONDUCTOR PHYSICS AND DEVICES** **3 0 0 3**

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

Course Outcomes (COs)

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3												
2	3	1												
3	1	1												
4	1	1												
5	1	2												

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill,2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

21GE0P3 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)
Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	1	2												
3	2	1												
4	1	1												
5	1	2												

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein''s prediction - Einstein''s relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement - holography

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting- Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006.

21GE0C1 CORROSION SCIENCE AND ENGINEERING 3 0 0 3

Course Objectives

- Understand the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2						1							
3	1	3												
4	2	2												
5	3	3					1							

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix diagrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

10 Hours

UNIT IV

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

FOR FURTHER READING

Corrosion issues in supercritical water reactor (SCWR) systems

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace IndependentPublishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science,2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.htm

21GE0C2 ENERGY STORING DEVICES 3 0 0 3

Course Objectives

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles
- Identify the types of fuel cells and to relate the factors of energy and environment
- Analyze various energy storage devices and fuel cells

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1.Explain the parameters required for operation of a cell to evaluate the capacity of energy storage devices

2.Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications

3. Differentiate fuel cells based on its construction, production of current and applications

4. Compare different methods of storing hydrogen fuel and its environmental applications

5.Relate energy and environmental based on the importance and types of renewable energy for sustainable development

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1												
2	2	3												
3	3	1												
4	2	2												
5	3	3												

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge-over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries - zinc-carbon, magnesium, and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries - introduction, cell reactions, cell representations and applications - lead acid, nickel-

cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell

Total: 45 Hours

Reference(s)

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009
2. F. Barbir,PEM fuel cells: Theory and practice, Elsevier, Burlington, MA, Academic Press, 2013
3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry,2001
4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012
5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016
6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010

21GE0C3 POLYMER SCIENCE 3 0 0 3

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers and its processing
- Identify suitable polymers for various industrial applications

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineeringproblems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Characterize the polymers to identify the structural, thermal ,mechanical and electrical features for specific applications
4. Apply the polymer processing methods to design polymer products
5. Identify and analyze the polymers used in electronic and biomedical applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	2												
4	1	1	2											
5	1	3	2											

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) - ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II **8 Hours**

POLYMERIZATIONTECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding andpultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration

FOR FURTHER READING

Biodegradable polymers

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2015
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2007
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York,2004
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011

21AG001 HUMAN ENGINEERING AND SAFETY 3 0 0 3

Course Objectives

- To know about the importance of ergonomics
- To design agricultural machinery, equipment, implements and tools that suits comfort for work
- To know about the safety in design and operation of agricultural machinery

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Assess the importance of ergonomics and its application in agriculture
2. Apply test procedures to take anthropometric data and measurement techniques
3. Design of controls and work space envelope
4. Apply the anthropometry in design of agricultural implements
5. Apply the safety standards at work place during various farm operations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		2	1									
2	3	2	2											
3	3	2	1											
4	1	2												
5	2					1	1							

UNIT I **8 Hours**

ERGONOMICS

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

UNIT II **9 Hours**

PHYSIOLOGICAL FUNCTIONS

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 **9 Hours**

ENERGY EXPENDITURE

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 **10 Hours**

ANTHROPOMETRY

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 **9 Hours**

HUMAN SAFETY

Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation.

FOR FURTHER READING

Analysis of case studies on ergonomic study of different farm implements and machinery

Total: 45 Hours

Reference(s)

1. Sanders,M.S. and McComack,EJ. Human factors in Engineering and Design. Tata McGraw Hill, New York, 1992
2. Obome, David.J. Engieering Work. John Wiley and Sons Ltd., 1982
3. Astand, P.P. and Rodaid,K. Text book of Work Physiology, McGraw Hill Book Company, New York, 1970
4. Grandjean,E. Fitting the Track of the Man, Taylor and France Ltd., U.K.,1981

21AG002 DESIGN OF AGRICULTURE MACHINERY

3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

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

ArticulationMatrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	2	1	1	1						1	1
2	2	2	3	1	1	1	1						1	
3	2	3	3	1	1	1	2							1
4	2	3	3	1	1	1	1	1					2	
5	2	3	3	1	1	1	1		1	1				

UNIT I **9 Hours**

INTRODUCTION

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 **9 Hours**

CONSTRUCTION OF PRIMARY TILLAGE IMPLEMENTS

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 **9 Hours**

CONSTRUCTION OF SECONDARY TILLAGE IMPLEMENTS

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 **9 Hours**

CALIBRATION OF SEED DRILL/PLANTER

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 **9 Hours**

DESIGN OF PLANT PROTECTION AND HARVESTING MACHINERY

Types of sprayers- components-nozzle types-selection of nozzles- spray pattern analysis. Harvesters-reapers-combine harvesters-threshers- special equipment for harvesting and threshing - maintenance inspection for safety.

FOR FURTHER READING

Design of power equipment, precision farming tools, design standards.

Total: 45 Hours

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

21AG003 TESTING AND EVALUATION OF FARM MACHINERY AND EQUIPMENT

3 0 0 3

Course Objectives

- To Learn the procedure for testing of tractors and all other agricultural equipment and machinery
- To understand test codes of various countries
- To analyse the performance of farm machinery and implements

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Apply the testing procedures and standards of tractor testing
2. Analyse the performance of tillage, sowing equipment using standards
3. Test the intercultural equipment using standard procedures
4. Evaluate the performance of harvesting equipment using testing procedures
5. Apply safety standards and testing procedures for agricultural machinery and implements

ArticulationMatrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	2	1	1	1						1	1
2	2	2	3	1	1	1	1						1	
3	2	3	3	1	1	1	2							1
4	2	3	3	1	1	1	1	1					2	
5	2	3	3	1	1	1	1		1	1				

UNIT I **10 Hours**

TESTING OF AGRICULTURAL TRACTORS

Testing and evaluation system in India - Agricultural machinery situation -Mechanization policy – future prospects - standardization efforts - type of testing systems – General regulations - terminology- basic measurements, speed, fuel consumption, smoke density and power measurement - test items, specifications checking - PTO performance test- engine test, drawbar performance test - field test procedures -interpretation of results

UNIT II **9 Hours**

TESTING OF TILLAGE AND SOWING EQUIPMENT

Testing of tillage machinery - laboratory test (hardness testing, chemical analysis) - field test (rate of work, quality of work, draft measurement, fuel consumption) - seed drill - laboratory test (seed drill calibration) - field checking and field tests

UNIT III **9 Hours**

TESTING OF INTERCULTURAL EQUIPMENT

Testing and evaluation of weeders - types of tests for weeder - types of pesticide application equipment - terminology - types of tests for sprayers - testing methods - types of test for duster - testing methods

UNIT IV **9 Hours**

TESTING OF COMBINE HARVESTER

Types of grain combines - combine systems - test items - procedure for laboratory testing - materials for field test - observations during field tests - sample analysis- data analysis - summary of performance parameters - analysis of field test data

UNIT V **8 Hours**

SAFETY TESTING OF AGRICULTURAL MACHINERY

Types of agricultural machinery accidents - causes of agricultural machinery accidents - technical| measurements for ensuring safety - methods of safety testing- ROPS and FOPS -safety precautions

FOR FURTHER READING

Design of cold storage

Total: 45 Hours

Reference(s)

1. Metha M.L., SR.Verma, K Mishra and VK Sharma. 1995. Testing and Evaluation of Agricultural Machinery, National Agricultural Technology Information Centre, Ludhiana
2. Indian Standards Test Codes related to tractors, power tillers and agricultural implements. Ministry of Agriculture, Govt. of India
3. ASABE. 1983. RNAM Test Codes & Procedures for Farm Machinery. Technical Series 12.
4. Nebraska Tractor Test Codes for Testing Tractors, Nebraska, USA.

21AG004 FARM POWER AND MACHINERY MANAGEMENT

3 0 0 3

Course Objectives

- To analyse mechanization status in the country and management techniques for future requirements.
- To apply the management concepts for farming practices

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Analyses the present status of farm mechanization in India
2. Estimate the cost of machinery and cost of operation.
3. Select optimal machinery for agricultural operations
4. Develop the plan for mechanization of the farm.
5. Create custom hiring centres for farming practices

ArticulationMatrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	2	1	1	1						1	1
2	2	2	3	1	1	1	1						1	
3	2	3	3	1	1	1	2							1
4	2	3	3	1	1	1	1	1					2	
5	2	3	3	1	1	1	1		1	1				

UNIT I **9 Hours**

FARM MECHANIZATION

The role of farm mechanization and its relationship to productivity, employment, social and Technological change.- Farm Power availability- Mechanization status in India–performance index of power source and farm machinery -Scheduling of farm operations

UNIT II **9 Hours**

COST ANALYSIS

Farm records and inventory control - cost analysis of machinery: fixed cost and variable costs, effect of inflation on cost;Cost economics of tractor and farm machinery – land preparation, planting , intercultural, plant protection and harvesting machinery cost calculation

UNIT III **9 Hours**

MACHINERY SELECTION

Selection of tractor and farm machinery – Matching implements for different hp- computation of hp requirement -optimum machinery and Replacement criteria; Break-even analysis, reliability and cash flow problems

UNIT IV **9 Hours**

FARM MACHINERY OPERATION AND MANAGEMENT

Operations and adjustments of Land preparation , planting, intercultural, plant protection and harvesting machinery – management of machinery .

UNIT V **9 Hours**

CUSTOM HIRING MODELS

Establishment of CHC-operationalization – Custom hiring models – case studies of custom hiring – Custom hiring project formulation – ownership vs custom hiring services- Economic viability of custom hiring service units – Replacement of farm machinery

FOR FURTHER READING

Case studies on farm management systems

Total: 45 Hours

Reference(s)

1. Mahajan M 2001. Industrial Engineering and Production Management Dhanpet Rai and Co (P) Ltd. New Delhi
2. Sharma D N and S.Mukesh, 2013. Farm Power and Machinery Management, Jain Brothers, New Delhi.

21AG005 HYDRAULIC DRIVES AND CONTROLS 3 0 0 3

Course Objectives

- To know about the application of hydraulics in agricultural machinery
- To design drives and controls agricultural machinery, equipment, and implements
- To know about the safety in design and operation of hydraulic drives

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Apply the hydraulic fundamentals in design of hydraulic system and controls
2. Design pumps for hydraulic systems applied in agricultural machinery techniques
3. Develop accumulators, and circuits for hydraulic systems
4. Select the valves and create valve circuit diagrams for troubleshooting
5. Apply the safety standards for hydraulic systems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	2	1	1	1						1	1
2	2	2	3	1	1	1	1						1	
3	2	3	3	1	1	1	2							1
4	2	3	3	1	1	1	1	1					2	
5	2	3	3	1	1	1	1		1	1				

UNIT I **9 Hours**

INTRODUCTION

Hydraulic Basics: Pascal's Law, Flow, Energy, Work, and Power. Hydraulic Systems, Color Coding, Reservoirs, Strainers and Filters, Filtering Material and Elements.

UNIT II **9 Hours**

PUMPS

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

UNIT III **9 Hours**

ACCUMULATORS, AND CIRCUITS

Accumulators, Pressure Gauges and Volume Meters, Hydraulic Circuit, Fittings and Connectors. Hydraulic Actuators, Cylinders, Construction and Applications, Maintenance, Hydraulic Motors.

UNIT IV **9 Hours**

VALVES

Valves, Pressure-Control Valves, Directional- Control Valves, Flow-Control Valves, Valve. Installation, Valve Failures and Remedies, Valve Assembly, Troubleshooting of Valves- Hydraulic Circuit Diagrams and Troubleshooting

UNIT V **9 Hours**

SAFETY AND CONTROLS

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

FOR FURTHER READING

Application of hydraulics in farm machinery, Hydraulic systems in harvesters and planters

Total: 45 Hours

Reference(s)

1. Manring, N. D. (2001). Hydraulic Control Systems: Design and Analysis of Their Dynamics. CRC Press.
2. Watanabe, K. (2003). Hydraulic Proportional and Servo Control Systems. CRC Press.
3. Sivaraman, I. (2015). Introduction to Hydraulics and Pneumatics. CRC Press.
4. Eaton Corporation. (2011). Industrial Hydraulics Manual. Eaton Corporation.
5. Daines, J. R., & Nelson, C. A. (1991). Fluid Power: Hydraulics and Pneumatics. Prentice Hall.

21AG006 PRECISION FARMING EQUIPMENT 3 0 0 3

Course Objectives

- To learn about the fundamentals of precision farming principles and application of precision farming equipment

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
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j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Investigate the role of sensors and electronics in precision farming
2. Analyse the principles and applications of sensors, micro controllers and actuators in precision farming equipment
3. Apply the precision farming concepts and machinery
4. Adopt site specific management system for precision farming practices
5. Analyse the application unmanned vehicles & IoT in farm operations

ArticulationMatrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	2	1	1	1					1	1	1
2	2	2	3	1	3	1	1					1	1	
3	2	3	3	1	3	1	2					1		1
4	2	3	3	1	3	1	1	1				1	2	
5	3	3	3	2	3	1	1		1	1		1		

UNIT I **9 Hours**

ROLE OF ELECTRONICS IN AGRICULTURAL ENGINEERING

Electronics in precision agriculture- Basics of precision agriculture- tools for implementation of precision agriculture. Introduction of GIS/GPS positioning system for precision farming. Use of GIS and GPS in farm machinery and equipment.

UNIT II **9 Hours**

SENSORS, MICROCONTROLLER AND ACTUATOR FOR PRECISION AGRICULTURE

Types of sensor- principle and concept of different sensor like ultrasonic, proximity, PIR, IR, radar, pressure, gas, temperature, moisture, strain /weight, colour sensor etc. used in agriculture. Microcontroller: Arduino, Raspberry Pi and PLC Actuator : DC Motor, Pump, linear Actuator etc. - Basic input circuits and signal conditioning systems – amplifiers and filters.

UNIT III **9 Hours**

RECISION FARMING CONCEPTS AND PRECISION FARMING MACHINERY

Precision farming concepts- Map based system- Real time system – Combination Map and real time system -components of PF – Site specific management- Constraints of PF- Precision tillage, planting, intercultural, plant protection and harvesting equipment, laser guided leveller, power sprayer, straw chopper cum spreader, straw bailer, combine harvester.

UNIT IV **9 Hours**

SITE-SPECIFIC MANAGEMENT SYSTEM

Site-specific nutrient management- weeds management- Agro-chemicals and fertilizer management, data sources and decision making for site-specific management. Grain quality and yield. Yield monitoring and mapping, soil sampling and analysis.

UNIT V **9 Hours**

UNMANNED VEHICLES AND IOT IN AGRICULTURE

UAV -Drones- Types - applications – rules and regulations – Autonomous ground vehicles – Robotics-platforms and unmanned agricultural vehicles- IoT - crop yield estimates- threat identification- crop insurance-pesticides spraying, environmental monitoring- protected cultivation- food quality monitoring.

FOR FURTHER READING

Case studies on precision farming practices and equipment

Total: 45 Hours

Reference(s)

1. Brase, T.A. 2006. Precision Agriculture. Thomson Delmar Learning, New York.
2. Hermann, J.H. 2013. Precision in Crop Farming, Site Specific Concepts and Sensing Methods: Applications and Results. Springer, Netherlands.
3. Krishna, K. R. 2016. Push Button Agriculture Robotics, Drones, Satellite-Guided Soil and Crop
4. Management. Apple Academic Press
5. Srivastava,A K., Carroll E.G., Roger P. R. and Dennis R.B.2006. Engineering Principles of
6. Agricultural Machines. American Society of Agricultural and Biological Engineers, USA.
7. Zhang, Q. 2015. Precision Agriculture Technology for Crop Farming. CRC Press, New York.
8. Kepner, R.A., Bainer, R. and Berger, E.L. 1978. Principles of Farm Machinery.AVI Publ.

21AG007 BUILDING MATERIALS, ESTIMATION AND COSTING 3 0 0 3

Course Objectives

- To understand the fundamental knowledge on different building materials
- To impart knowledge on design of different aspects of building construction
- To learn to prepare detailed estimate and cost estimate of buildings

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Classify rocks, bricks and clay products based on their characteristics and examine the manufacturing process of bricks including moulding, drying and burning for its properties
2. Assess the natural resources of lime, its types and timber qualities and test for water cement ratio in manufacturing Portland cement.
3. Organize foundation, stone masonry and brick masonry and compare stone masonry and brickmasonry
4. Construct the buildings by considering dampness, mortar, foundation and concrete
5. Find the cost estimate based on the public works department schedule rates.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		1			1							2
2	2	1	1	2	1		1							2
3	1	2	2	1	1		3						1	
4	1	2	3				1							
5	2	2	2				1							

UNIT I **9 Hours**

CONSTRUCTION MATERIALS

Classification of rocks - Characteristics of Stones -Testing of Stones-Manufacture of Bricks - Moulding -Drying and Burning of bricks-Properties of good Brick -Classification of bricks -Clay Products-Ceramics - Tiles - Earthenware and Stoneware and uses

UNIT II **8 Hours**

LIME AND CEMENT

Lime- Natural Sources -Types of lime - Calcination-Cement -Raw materials - Water Cement Ratio. Manufacture of Portland Cement Wet and Dry process-Standard Specifications- Storage of cement. Timber - Definition - Defects in timber-Qualities of good timber.

UNIT III **9 Hours**

BRICK, STONE MASONRY AND FOUNDATION

Concept of Foundation -Factors affecting Selection of Foundations -Types of soils-Subsurface Investigations -Bearing Capacity of soil -Testing & Improving Bearing Capacity of soil- Types of Foundations-Piles -Foundation in Black Cotton soil-Site Selection - General principles - classification of brick masonry-precautions in brick masonry -Stone Masonry -Comparison between Brick and Stone Masonry -Classification -General Principles and precautions in stone masonry

UNIT IV **9 Hours**

BUILDING CONSTRUCTION

Walls -Classification of walls - Dampness -Causes of Dampness -Methods of Preventing Dampness - Damp Proofing materials - Methods of providing Damp Proofing Materials-Mortars -Functions and Types of mortars -Concrete -Characteristics -Types and uses - Cube Strength of Concrete-Roofs - Classification - Floors -Types of Floor-Types of Plastering and Pointing -Painting and Distempering

UNIT V **10 Hours**

ESTIMATING AND COSTING

PWD schedule of rates - data sheet - detailed estimate - abstract estimate - preparation of estimate market rate estimation

FOR FURTHER READING

Estimating and costing of farm structures- irrigation systems- farm ponds- poultry shed- dairy barn

Total: 45 Hours

Reference(s)

1. B.N. Datta, Estimation and costing. Published by the Author, Tagore Palli, Motilal Bose road, Lucknow, 2002
2. S.C Rangwala, Estimating and costing, Charotar book stall, Station road, Anand, 1991.
3. N.L. Arora and B.R. Gupta, Building construction. Sathyaprakasham, 16/7698, New market, New Rohtak road, New Delhi -5, 1995
4. B.L. Handoo and V.M. Mahajan, Civil engineering materials. Sathyaprakasam, 16/7698, New market, New Rohtak road, New Delhi-5, 1995
5. S.C. Rangwala, Building construction, Charotar publishing house, Anand, 2000
6. S.V Deodhar and Singhal, Civil engineering materials. Khanna publishers, 2B, Nath market, Naisark, Delhi - 2001

21AG008 GROUNDWATER, WELLS AND PUMPS 3 0 0 3

Course Objectives

- To provide students with an understanding of the principles of groundwater and its behavior
- To introduce the methods and technologies used in groundwater exploration, development, and management
- To familiarize students with the design and installation of wells and pumping systems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Execute the sources and availability of groundwater in a given area.
2. Design and construct wells for accessing groundwater.
3. Select and operate pumps for groundwater extraction.
4. Organize the water quality of groundwater resources.
5. Find sustainable management practices for groundwater resources

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		1			1							2
2	2	1	1	2	1		1							2
3	1	2	2	1	1		3						1	
4	1	2	3				1							
5	2	2	2				1							

UNIT I **9 Hours**

INTRODUCTION TO GROUNDWATER RESOURCES

Sources and availability of groundwater, groundwater exploration methods, hydrologic cycle and water budget, water quality parameters and their significance, water scarcity issues and solutions.

UNIT II **9 Hours**

WELLS

Types of wells, design principles and construction methods, borehole logging and interpretation, well development, well rehabilitation, wellhead protection, well maintenance and troubleshooting.

UNIT III **9 Hours**

PUMPS

Types of pumps and their selection criteria, operating characteristics and performance evaluation, pump installation and operation, energy efficiency of pumps, pump maintenance and troubleshooting.

UNIT IV **9 Hours**

GROUNDWATER QUALITY

Parameters affecting water quality, water quality standards and guidelines, water quality testing methods, interpretation of water quality data, water treatment options, safe use and disposal of water.

UNIT V **10 Hours**

SUSTAINABLE GROUNDWATER MANAGEMENT

Groundwater management principles, groundwater monitoring and modeling, groundwater recharge techniques, conjunctive use of surface and groundwater resources, integrated water resources management, policies and regulations for sustainable groundwater management.

FOR FURTHER READING

Estimating and costing of farm structures- irrigation systems- farm ponds- poultry shed- dairy barn

Total: 45 Hours

Reference(s)

1. David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007
2. Bhagu R. Chahar, Groundwater Hydrology, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017
3. Subramanya K, Fluid Mechanics and Hydraulic Machines: Problems and Solutions, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2018.
4. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.

21AG009 PROTECTED CULTIVATION 3 0 0 3

Course Objectives

- To impart knowledge on the protected cultivation of vegetables, fruits and flower crops.
- To sensitize the students on hi-tech production technology of fruits and vegetables
- To learn and practices the various production practices of flower and other high value crops

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Course Outcomes (COs)

1. Execute the different methods of protected cultivation practices available for vegetable crops and flowers
2. Assess the technology available for vegetable crops
3. Assess the technology available for flower crops
4. Select precision farming techniques using sensors and Geographic information systems for the crops
5. Implement the technology available for horticulture crops

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	1	2							1		
2	2	3	3	1	2							2		
3	2	2	2	1	2	1						1		
4	2	3	3	1	2		1					1		
5	2	2	3	1	2							1		

UNIT I **9 Hours**

PROTECTED CULTIVATION AND ITS TYPES

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 greenhouse 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 **9 Hours**

PROTECTED CULTIVATION OF VEGETABLE CROPS

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 **9 Hours**

PROTECTED CULTIVATION OF FLOWER CROPS

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 **9 Hours**

PRECISION FARMING TECHNIQUES

Concept and introduction of precision Farming: 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.

UNIT V **9 Hours**

PRECISION FARMING OF CROPS

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,VRT, robotics and drones in agriculture 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.

FOR FURTHER READING

Design of greenhouse roof trusses, sorting, grading and packing of fruits, vegetables and flowers, and their transportation to market.

Total: 45 Hours

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 greenhouse 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

21AG010 DESIGN OF MICRO IRRIGATION SYSTEMS 3 0 0 3

Course Objectives

- 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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Categorize the different types of pumps and water lifting devices based on the principle, components, and working efficiency
2. Execute 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
3. Estimate water budgets and hydraulics used to develop irrigation schedules through micro irrigation based on crop geometry
4. Design drip and sprinkler irrigation system including, main line, sub main and laterals designs by consider pump capacity
5. Assess greenhouse irrigation system and advanced types of irrigation including lift irrigation and automation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	2	2	1	1					1		
2	2	2	3	2	2	1	1					2		2
3	2	2	3	2	2	1	1					1	1	
4	2	2	3	3	2	1	1					1		
5	2	2	3	2	2	1	1					1		

UNIT I **9 Hours**

TYPES OF PUMPS AND OTHER WATER LIFTING DEVICES

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 **12 Hours**

CENTRIFUGAL, SUBMERSIBLE AND TURBINE PUMPS

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 **7 Hours**

WATER BUDGETING AND DRIP IRRIGATION DESIGN

Micro irrigation: classification, Irrigation scheduling, Water Budgeting with micro irrigation. Hydraulics of micro irrigation components. Valves, planning factors. Wetting pattern, crop geometries.

UNIT IV **10 Hours**

SPRINKLER IRRIGATION DESIGN

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 the sprinkler irrigation system.

UNIT V **7 Hours**

SPECIAL TYPES OF IRRIGATION

Greenhouse irrigation system, design. Lift irrigation system: Design, subsurface drip irrigation. Soil less culture, Fertigation, Automated irrigation system and rain gun

FOR FURTHER READING

Project preparations: Design and draw the layout of a drip/sprinkler irrigation system for 10 acres, preparation of project proposal for the installation and commissioning of irrigation systems

Total: 45 Hours

Reference(s)

1. V.Ravikumar and M.V.Ranghaswami, Micro irrigation and irrigation pumps. Kalyani Publishers, Ludhiana. 2011
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

21AG011 WATERSHED PLANNING AND MANAGEMENT 3 0 0 3

Course Objectives

- To acquire knowledge about the principles of watershed development activities
- To understand the hydrological responses of a watershed and its control measures
- To investigate the applicability of hydrological models for watershed conservation

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Assess the watershed characteristics for their classification and prioritization
2. Execute the watershed planning activities based on the inventory and scope
3. Find the needs, methods and implementation strategies of watershed management projects
4. Assess the watershed responses for suggesting suitable control measures
5. Organize the selection of hydrologic models for watershed management

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2					3							1	
2						3	2						1	
3						2	3						1	
4	1	2	3			1	2						1	
5	1				3		2						1	

UNIT I **9 Hours**

WATERSHED CHARACTERISTICS

Watershed – concept and objectives; watershed classifications – land use and capabilities; watershed delineation – toposheets – codification; watershed priorities – Indian scenario – watershed issues

UNIT II **9 Hours**

WATERSHED PLANNING

Watershed resources inventory – land use data – hydrologic data; Planning principles – watershed development plan; Planning process - scope and objectives – step-wise process; Implementation strategy – monitoring and evaluation system

UNIT III **9 Hours**

WATERSHED MANAGEMENT

Project proposal formulation – action plan – watershed economics; Runoff management – temporary and permanent soil conservation structures – water conservation practices; Participatory watershed management – watershed based rural development; National programmes on watershed management – Govt. of India guidelines

UNIT IV **9 Hours**

WATERSHED RESPONSES

Estimation of water yield – analysis of overland flow and rainwater harvesting – assessment and management perspectives – development of recharge structures; estimation of soil erosion – measurement and controls; estimation of sediment yield – measurement and controls; watershed prioritization – index-based models – morphometric analysis

UNIT V **9 Hours**

WATERSHED MODELS

Hydrologic modelling – basic principles – objectives and scope; classification of watershed models – empirical – conceptual – physical-based; Selection of watershed model – suitability – model assessment – sensitivity analysis; Major watershed models – governing equations – software tools – working principles – exercises to practice

FOR FURTHER READING

GIS for watershed management; Case studies in watershed development projects; decision support system for watershed management

Total: 45 Hours

Reference(s)

1. Ghanashyam Das, Hydrology and Soil Conservation engineering, Prentice Hall of India Private Limited, New Delhi, 2000
2. Suresh R, Land and water management principles, Standard Publishers & Distributors, New Delhi, 2008
3. K. Palanisami, V. N. Sharda and D. V. Singh, Water management in the Hill regions-Evidences from field studies. Bloomsbury Publishing India Pvt. Ltd, 2013
4. Das M, Saikia MD, Watershed management, PHI Learning, 2013
5. Brooks KN, Ffolliott PF, Magner JA, Hydrology and the Management of Watersheds, Wiley-Blackwell, Ames, IA, USA, 2013

21AG012 RESERVOIR AND FARM POND DESIGN 3 0 0 3

Course Objectives

- To acquire knowledge about water harvesting structures and their design
- To understand the design aspects of reservoirs and farm ponds
- To infer the design, operation and maintenance of reservoirs and farm ponds

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Assess the hydrological and watershed concepts of reservoirs and farm ponds
2. Design of reservoirs, embankment ponds and excavation ponds
3. Assess the seepage discharge and its impact on stability aspects of the dams
4. Find the constructional, operational and maintenance aspects of reservoirs and farm ponds
5. Organize the economic indicators for the cost-benefit analysis of water harvesting projects

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1	2				1						2	
2	2	1	3				1						2	
3	2	2	3				2						1	
4		2	3			1	1						1	
5		2				2	3						2	

UNIT I **9 Hours**

FUNDAMENTALS OF RESERVOIR AND FARM PONDS

Water harvesting – hydrological aspects – watershed aspects – topographical aspects for location; General Considerations - Drainage Area – pond capacity - landscape Evaluation; Reservoir dam – classification – selection criteria; Farm ponds – classification – design criteria

UNIT II **9 Hours**

DESIGN ASPECTS OF RESERVOIR AND FARM POND

Earthen embankments - functions, advantages and disadvantages – classification – hydraulic fill and rolled fill dams; Basic Design Concepts - Site Selection – foundation requirements – grouting; Harvesting Principles – components; Catchment and Reservoir Yield – Estimating Storm Runoff – Design Catchment Yield – Dependable Flow; Excavated Ponds – soils Investigation – spillway and Inlet Requirements – planning and construction

UNIT III **9 Hours**

SEEPAGE AND STABILITY ANALYSIS

Estimation of seepage discharge – location of seepage/phreatic line – graphical and analytical methods – flow-net and its properties – seepage pressure – seepage line in composite earth embankments – drainage filters – piping and its causes - Drainage System for Seepage Control - Stability of slopes – analysis of failure by slice method; Stability of earthen embankments against failure by tension, overturning, sliding etc. – Slope Protection

UNIT IV **9 Hours**

CONSTRUCTION OF EARTHEN DAM

Earthen dam – Staking for Construction – construction methods and specifications; Considerations in Implementation – checking with compliance standards – sealing methods; Considerations in maintenance – Monitoring, Evaluation and protection – extension and Training; Miscellaneous aspects – water quality considerations – seepage and evaporation reduction measures – runoff inducement methods

UNIT V **9 Hours**

ECONOMIC ANALYSIS OF FARM POND AND RESERVOIR

Estimation of earth work; Cost analysis - Initial Investment - Variable Cost - Annual Returns – present worth Analysis; Economic Indicators - Net Present Value - Benefit Cost-ratio - Internal Rate of Return - Payback Period

FOR FURTHER READING

Other Water Harvesting Structures - Appurtenant Structures – Design of Dam Components

Total: 45 Hours

Reference(s)

1. Murthy, V.V.N. and Jha. M. K. (2011). Land and Water Management Engineering. Kalyani Publication.
2. Garg, S. K. (2011). Irrigation Engineering and Hydraulic Structures. Khanna Publishers
3. Theib YO, Dieter P, Ahmed YH, Rainwater Harvesting for
4. Agriculture in the Dry Areas, CRC Press, Taylor and Francis Group, London, 2012
5. Suresh R, Soil and Water Conservation Engineering, Standard Publisher Distributors, New Delhi, 2014

21AG013 REFRIGERATION AND COLD STORAGE 3 0 0 3

Course Objectives

- To interpret principles of operation of different Refrigeration & Air conditioning systems
- To understand the types of compressors and expansion devices and their applications
- To combine the parameters involved in design of the various air conditioning systems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Execute the principles and practice of thermal comfort
2. Analyse the vapor compression and heat-driven refrigeration systems
3. Apply the knowledge on psychrometric chart for designing heating and refrigeration units
4. Find various types of air conditioning systems and their application in food industry
5. Evaluate applications and make design calculations of Heating, Ventilation and Air conditioning systems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2	1	1							1		1
2	1	3	2	2	1							1		1
3	3	2	2	1	1							1		1
4	1	3	2	2	1	1			1					1
5	2	2	3	1	1									2

UNIT I **10 Hours**

REFRIGERATION PRINCIPLES AND COMPONENTS

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

UNIT II **8 Hours**

VAPOUR COMPRESSION AND VAPOUR ABSORPTION CYCLE

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 **9 Hours**

APPLIED PSYCHROMETRY

Principle and properties of psychrometry, Representation of various psychrometric processes on psychrometric 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 psychrometric charts. Cooling and heating load calculations

UNIT IV **8 Hours**

AIR CONDITIONING SYSTEM

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 **10 Hours**

APPLICATIONS OF REFRIGERATION IN FOOD PROCESSING AND PRESERVATION

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.

FOR FURTHER READING

Design of cold storage

Total: 45 Hours

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

21AG014 FRUITS AND VEGETABLE PROCESSING 3 0 0 3

Course Objectives

- Implement specific post-harvest handling technique for storage and transport of fruits and vegetables
- Apply preservation techniques to produce value added fruits and vegetable products
- Learn the industrial scale processing and preservation methods to extend the shelf life of fruit and vegetable commodities

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Find low temperature, modified atmosphere and controlled atmospheric storage methods for storage of fruits and vegetables
2. Find value added products from fruits and vegetables by using suitable preservation method
3. Find dehydrated fruits and vegetables
4. Assess minimal processing and fermentation methods to produce value added products from fruits and vegetables
5. Assess the produce canned and bottled fruits and vegetables

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1				2								1
2	2				2									2
3	2	1		2										1
4	2		2	1										1
5	2			2	2									2

UNIT I **9 Hours**

HARVESTING, HANDLING AND STORAGE OF FRUITS AND VEGETABLES

Fruits and vegetables: classification, nutritional profile - Harvesting of fruits and vegetables - maturity indices - post harvest physiology - handling - precooling and storage - Storage under ambient condition, low temperature storage - chilling, frozen storage- chilling injury, freeze burn. Controlled atmosphere storage, Modified atmosphere storage - concepts and methods - gas composition - Changes during storage

UNIT II **9 Hours**

PRESERVATION OF FRUITS AND VEGETABLES BY VALUE ADDITION

Methods of fruit and vegetable preservation - Processing using sugar- Preparation of jam, jelly, marmalade, squash, RTS, crush, nectar, cordial, fruit bar, preserves, candies and carbonated, fruit beverages. Processing using salt - Brining - Preparation of pickles, chutney and sauces, ketchup. Machinery involved in processing of fruits and vegetables products.

UNIT III **9 Hours**

PRESERVATION BY DRYING AND DEHYDRATION

Drying and dehydration - Types of driers - Solar, cabinet, fluidized bed drier, spouted bed drier, heat pump drier, vacuum drier and freeze drier - Applications. Preparation of product. Changes during drying and dehydration. Problems related to storage of dried and dehydrated products.

UNIT IV **9 Hours**

MINIMAL PROCESSING AND FERMENTATION

Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables, Minimal Processing of Fruits and Vegetables. Preservation by fermentation - wine, vinegar, cider and sauerkraut.

UNIT V **9 Hours**

CANNING AND BOTTLING

Canning - principles, types of cans - preparation of canned products - packing of canned products - spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations. General considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit.

FOR FURTHER READING

Toping of sugar/salt, Hybrid drier, safe level of irradiation, solid state fermentation, layout of fruit/vegetable canning unit

Total: 45 Hours

Reference(s)

1. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Third Edition, CBS Publishers & Distributors-New Delhi, 2002.
2. A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003.
3. Girdhari Lal, G. S.Siddappa and G.L. Tandon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 2009.
4. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.
5. K.Sharma, Stevan J.Mulvaney and Syed S.H. Rizvi, Food Process Engineering-Theory and Laboratory equipments, John Wiley & Sons, New York, 2000.

21AG015 FOOD AND DAIRY ENGINEERING 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post-harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

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

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2	1	1						1			1
2	2	1	3	2	1	1								
3	1	2	3	2	1		-				1		1	
4	3	1	1	1	1	1								2
5	1	2	1	1	1						1		1	

UNIT I **8 Hours**

BASIC PROPERTIES OF FOOD MATERIALS

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

UNIT II **10 Hours**

THERMAL PROCESSING OF FOODS

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-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 **9 Hours**

DRYING AND DEHYDRATION

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 **8 Hours**

MILK PROCESSING

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 **10 Hours**

DAIRY EQUIPMENT AND PRODUCTS

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

FOR FURTHER READING

Waste utilisation and energy conservation in dairy industry - Utilisation of whey for energy generation through biomethanation, energy conservation opportunities in dairy industry and packaging of dry products.

Total: 45 Hours

Reference(s)

1. H.G.Kessler, Food Engineering and Dairy Technology, Freising, Germany, Verlag A.Kessler, 1981
2. 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
3. Gordon L. Robertson, Food Packaging- Principles and Practice Marcel Dekker Inc, USA, 1993
4. Sukumar De, Outlines of Dairy: Technology, Oxford University Press, 2001

21AG016 FOOD SAFETY MANAGEMENT SYSTEMS 3 0 0 3

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it
- Learn common causes of foodborne illness - viz. physical, chemical and biological and identification through food analysis
- Understand food inspection procedures employed in maintaining food quality

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
n. To improvise better ways to minimize the crop loss from field damage during post-harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Analyse the sources of food spoilage and food toxicants.
2. Assess the food quality evaluation methods.
3. Execute the food inspection procedures to evaluate the food quality
4. Select the National and International Food laws and regulations.
5. Evaluate the quality control measures in food processing industry and marketing centres

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		1				3						2		2	
2		3				3	1		2			1		2	
3		3							1		1	1		1	
4	3				2							1		1	
5	2	2	2			1			1			3		1	

UNIT I **9 Hours**

FOOD SAFETY

Food safety - General principles of food safety. Characterization of food Hazards - physical, chemical and biological. Food spoilage and food borne infection hazards-sources of food spoilage and microorganisms-microbial problems in food safety-food toxicants and food poisoning - prevention. Cross contamination, Limits for pesticide and metal contamination of food. Adulteration, Food additives- types- usage, permissible limits, concept of safe food.

UNIT II **9 Hours**

FOOD QUALITY AND QUALITY EVALUATION OF FOODS

Food Quality - its need and its role in Food Industry. Food Quality and Quality Attributes-Classification of Quality Attributes and their role in food Quality. Quality Assessment of Food materials -Fruits, vegetables, cereals, legumes, dairy products, meat, poultry, egg and processed food. Sensory Evaluation of Food Quality. Requirements for conducting Sensory Evaluation, Methods of Sensory Evaluation and Evaluation cards, Different methods of Quantitative descriptive analysis.

UNIT III **9 Hours**

QUALITY CONTROL

Objectives, Importance and Functions of Quality Control, Quality control specifications, training of food technologists for quality control, implementation of standards and specifications. Quality control, principles of quality control - raw material control, process control, finished product inspection, process control, quality problems and quality improvement techniques- mechanization, future of quality control, Total quality management. Objective/Instrumental analysis of Quality Control.

UNIT IV **12 Hours**

NATIONAL AND INTERNATIONAL FOOD LAWS AND STANDARDS

Standards for food packaging and labelling - FSSAI, Bureau of Indian Standards (BIS), Agricultural Grading and Marketing (AGMARK), The Agricultural and Processed Food Product Export Development Authority (APEDA), MPEDA. Food and Drug Administration Act (FDA), International Organization for Standards (ISO) and its implication, Generally recognized as safe (GRAS), European Council (EU), Codex Alimentarius Commission (CAC), Total Quality Management (TQM), Good Manufacturing Practices (GMP), Good Agricultural Practices(GAP), and Good Hygienic Practices (GHP) , GMP, Hazard Analysis Critical Control Point (HACCP), FSMA, Legal Metrology Rules, Food Safety Standards for Organic foods, GFSi, HALAL and KOSHE.

UNIT V **6 Hours**

QUALITY CONTROL MEASURES IN INDUSTRIAL AND MARKETING CENTRES

Quality control system in storage, Quality control aspects in food industries, Importance of quality control in marketing of Food products - domestic and export markets. International standards for export and quarantine requirements for export of Agricultural and Horticultural produce.

Total: 45 Hour

Reference(s)

1. Manoranjan Kalia, Food analysis and Quality control, Kalyani Publishers, Ludhiana, 2002.
2. Mehta, Rajesh and J. George, Food Safety Regulation Concerns and Trade: The Developing Country
Perspective, Macmillan, 2005.
3. P.A. Luning, F. Devlieghere and R. Verhe, Safety in the agri - food chain, Wageningen Academic
Publishers, Netherland, 2006.
4. Leo and M.L. Nollet, Handbook of food analysis - Methods and Instruments in applied food analysis, Marcel
Dekker Inc., 2004.
5. J. Andres Vasconcellos,Quality Assurance for the Food Industry: A Practical Approach,1st Edition,2003.
6. V Ravishankar Rai, Jamuna A Bai,Food Safety and Protection 1st Edition,CRC Press,2017

21AG017 EMERGING TECHNOLOGIES IN FOOD PROCESS ENGINEERING 3 0 0 3

Course Objectives

- To understand the different emerging technologies in processing food
- To familiarize about the equipments used for the processing of foods by emerging technologies
- To understand about alternate thermal and non thermal processing techniques

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Assess the knowledge on application of High pressure processing and pulsed electric field processing
2. Apply the pulsed electric field processing for food preservation
3. Analyse the importance of irradiation in food processing
4. Determine the efficacy of non-thermal techniques for processing food products
5. Select a suitable thermal processing technique for the given food product

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
1	2	2	3	1	2	1						1		
2	2	2	3	2	1	1			-			1		
3	2	2	3	2	1	1						1		
4	2	2	3	2	1	1						1		
5	2	2	3	2	1	1						1		

UNIT I **9 Hours**

HIGH PRESSURE PROCESSING

Principles: Mechanism and applications of high pressure processing to food systems; High pressure processing of salads, meats and sea foods, fruits and fruit products; Effect of high pressure on microorganisms, enzymes, textural and nutritional quality of foods; Other applications of high pressure processing; High Pressure Freezing: principles and equipment, types of high pressure freezing process, microbiological and enzymatic inactivation after high pressure freezing.

UNIT II **8 Hours**

PULSED ELECTRIC FIELDS PROCESSING

Principles, Mechanism, PEF treatment systems, Main processing parameters; PEF technology: Equipments, Applications; Mechanisms of microbial and enzyme inactivation. PEF processing of solid foods, liquid foods and beverages. Food safety aspects of pulsed electric fields.

UNIT III **8 Hours**

FOOD IRRADIATION

Introduction: Fundamentals of food Irradiation, Type and sources of radiation, dosimetry, mode of action of ionizing radiation; Direct and indirect effect, radiation effect on food constituents, Dose requirement for different products and regulations

UNIT IV **14 Hours**

ALTERNATIVE NON THERMAL PROCESSING TECHNIQUES

High intensity pulsed light technology: principles of PLT technology, Technological aspects of PLT, Effects of PLT technology on microorganisms and food quality. Ultrasound Processing: Principle of ultrasound, Fundamentals, Ultrasound as a processing and food preservation tool, Effect of ultra sound on properties of foods, Applications of ultrasound in microbial inactivation, assisted drying, extraction, osmotic dehydration, detection of foreign bodies, filtration and freezing, challenges in ultrasound processing. Radio frequency electric fields: Introduction, radio frequency electric fields equipment, effect of radio frequency electrical field on inactivation of microorganisms.

UNIT V **6 Hours**

ALTERNATIVE THERMAL PROCESSING TECHNIQUES

Microwave heating and microwave drying: Microwaves, dielectric properties of foods, thermal properties of foods, Recent developments in microwave heating, combined microwave-vacuum drying, microwave freeze-drying, applications; Radio-frequency processing: Introduction, dielectric heating, Radio- Frequency applications for heating and drying.

FOR FURTHER READINGS

preservation methods for food product to extend shelf life

Total: 45 Hours

Reference(s)

1. Emerging Technologies for Food Processing. Da-Wen Sun (Ed), Academic Press, 1st Edition, 2005.
2. Novel Food Processing Technologies. M. P. Cano, M. S. Tapia, and G. V. BarbosaCanovas, CRC Press, 1st Edition, 2004.
3. Maria Laura Passos, Claudio P. Ribeiro, Innovation in Food Engineering: New Techniques and Products, CRC press, 2010.
4. Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V. M.Balasubramaniam, C. Patrick Dunne, Daniel F. Farkas, James T. C. Yuan, Nonthermal Processing Technologies for Food, 2000

21AG019 **BIO AND THERMOCHEMICAL CONVERSION OF BIOMASS** **3 0 0 3**

Course Objectives

- To acquire knowledge on the biomass characteristics and biochemical conversion technologies of biomass for energy generation
- To learn thermochemical conversion technologies for converting biomass into energy
- To understand the cogeneration system and waste heat recovery.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Assess the basics of biomass characteristics and supply chain management of biomass
2. Organise the biochemical conversion technologies of biomass for energy generation
3. Select the principles of the combustion process for converting biomass into energy
4. Analyze thermochemical conversion technologies of biomass for energy generation
5. Oragnise the basics of cogeneration and CDM technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3	2	3									
2	1	2	1	3	1		1							
3	3	1	2	2	3		1							
4	2	3	1	3	2		1							
5	1	2	1	3	2		1							

UNIT I **9 Hours**

BIOMASS CHARACTERIZATION

Biomass - types – biomass conversion process - fuel from biomass; Photosynthesis; Terms and units used in biomass production. Biomass characterization - physical, chemical, and thermal – energy release; Supply chain Management – harvesting/collection - transportation and processing – Importance; Briquetting – types of equipment – Factors affecting; Pelletizing.

UNIT II **11 Hours**

BIOCHEMICAL CONVERSION

Biochemical degradation – Feedstock for biogas production – Process involved - Factors affecting biogas production - Types of biogas plants – Construction details - Operation and maintenance - Utilization of biogas -Slurry handling, utilization and enrichment - high rate bio methanation process - landfills - Bioethanol - feedstock - process – utilization -- composting - methods machinery- Economics of biofuels

UNIT III **9 Hours**

THERMOCHEMICAL CONVERSION BY COMBUSTION

Thermochemical degradation - stoichiometric air requirement - Combustion process - chemistry of combustion - combustion zones – emissions; Co-firing of biomass – types (Direct, Indirect, and Parallel); Wood burning stoves - types- operation; Incinerators – Types – Combustion of wastes and MSW.

UNIT IV **9 Hours**

THERMOCHEMICAL CONVERSION BY GASIFICATION AND PYROLYSIS

Biomass gasification - chemistry of gasification - types of gasifiers - Gas cleaning & conditioning - utilization of producer gas - emissions - commercial gasifier. Pyrolysis - product recovery - types - biochar - bio-oil - operation recovery

UNIT V **7 Hours**

COGENERATION AND WASTE HEAT RECOVERY

Cogeneration technology - cycles - topping - bottoming - problems – applications; waste heat recovery – heat pipe – heat wheel – Recuperator – Economiser; Carbon cycle; Carbon sequestration – Types – benefits; CDM Concept – CDM Technologies – Carbon Emission Reduction

FOR FURTHER READING

Combustion Fundamental, Basic cycles, and Co-generation plant case studies

Total: 45 Hours

Reference(s)

1. Khoiyangbam. R.S, Kumar. S, Gupta.N, Biogas Technology: Towards Sustainable Development. India, Energy and Resources Institute, 2011.
2. Sergio C. Capareda, Introduction to Biomass Energy Conversions, CRC Press, 2014.
3. C.Higmen and M.Vander Burgt, Gasification, Elsevier Science, USA, 2003
4. Ashok Pandy, Thallada Baskar, M.Stocker and Rajeev Sukumaran (Editors), Recent advances in Thermochemical conversion of Biomass. Elsevier Publications, 2015
5. A.N. Mathur and N.S. Rathore, Biogas production Management and Utilisation, Himanshu Publications, New Delhi, 1993
6. Robert C Brown, Christian Steven (Editors), Thermochemical Processing of Biomass: Conversion into Fuels, chemical and powder, Wiley Eastern Publishers, 2011
7. K.C. Khandelwal and S.S. Mahdi, Biogas Technology, Tata McGraw Hill Pub. Co. Ltd., New Delhi,1986
8. O.P.Chawla, - Advances in Biogas Technology, ICAR Publication, New Delhi, 1986

21AG020 SOLAR AND WIND ENGINEERING 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Assess the basics of solar energy and solar thermal energy conversion technologies and compare direct mode and indirect mode solar dryers
2. Organise the principles and applications of solar thermal power stations, solar pond, and solar stills
3. Find the wind power laws and calculate the torque and power characteristics of wind energy
4. Design wind mills and test the units for certification
5. Assess the principles of geothermal energy, wave energy, tidal energy, OTEC energy, fuel cells and analyse their applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3	2	3		1							
2	1	2	1	3	1		1							
3	3	1	2	2	3		1							
4	2	3	1	3	2		1							
5	1	2	1	3	2		1							

UNIT I **9 Hours**

SOLAR ENERGY RADIATION AND NON-CONCENTRATING COLLECTORS

Solar constant; Solar Radiation Types – Geometry – measurement - Pyranometer, Pyrheliometer; Greenhouse Effect; Flat Plate Collector – transmittance – absorptance – Energy Balance Equation – collector efficiency - absorber plate - types - selective surfaces; Solar Dyer – Direct, Indirect and Combined Mode – Application.

UNIT II **9 Hours**

SOLAR CONCENTRATING COLLECTORS AND PV TECHNOLOGY

Line-focusing and point-focusing concentrators - parabolic trough, parabolic dish, heliostat field with central receiver, Fresnel lenses, compound parabolic concentrator - Sun tracking mechanisms; Solar Still – Types – Uses; Solar Pond – characteristics – application. Photovoltaics types (Mono, Poly, Thin Film, Mono PERC, Bifacial PERC) - characteristic - load estimation batteries inverters operation system controls. Module mounting structure - Tracking system - module cleaning system – PV-powered water pumping system sizing.

UNIT III **9 Hours**

WIND MAPPING ANALYSIS AND CHARACTERISTICS OF WIND

Nature of wind – the origin of wind – Energy in a moving object – Power in the wind – Power absorption by a turbine; Wind speed variation; Velocity and Power duration curve; Wind Resource Assessment; Aerodynamic Force – Lift and Drag Coefficient; Aerofoil - tip speed ratio - torque and power characteristics - Betz coefficient.

UNIT IV **9 Hours**

WIND ENERGY CONVERSION SYSTEM

Wind Turbines Classification – Upwind and Downwind Turbine – Savonius and Darrieus Turbine – Propeller Wind Turbine; Wind Turbine Components – Rotor – Drivetrain – Gearbox – Brake – Generator – Nacelle – Yaw System – Tower; Standalone system - grid system -batteries. Wind energy storage - wind farms - wheeling and banking - testing and certification procedures.

UNIT V **9 Hours**

ALTERNATE ENERGY SOURCES

Ocean energy - offshore and onshore 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.

FOR FURTHER READING

Application of solar water pump and dryer, Energy storage, and conversion technology

Total: 45 Hours

Reference(s)

1. Rai.G.D, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 2018.
2. Rao.S., Parulekar.B.B, Energy Technology Non-Conventional, Renewable & Conventional, Khanna Publishers, New Delhi, 2015.
3. Ahmad Hemami, Wind Turbine Technology, Cengage Learning, New Delhi, 2012.

21AG021 **ENERGY CONSERVATION IN AGRO-BASED INDUSTRY** **3 0 0 3**

Course Objectives

- To learn about the basic process carried out in various Agro-based Industries
- To learn the different aspects of energy auditing in the Food Industry
- To know about the energy saving opportunities in existing food processing facilities

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Model, design and analyze agricultural machinery and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticides and fuel
n. To improvise better ways to minimize the crop loss from field damage during post-harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Find the energy resources based on sources and purposes
2. Organize the types of energy audits in production agriculture for rural living and the scope of energy conservation
3. Assess the energy-efficient machinery systems and analyze the technologies and methods for the conservation of energy resources
4. Find the factors affecting energy conservation and analyze the energy economics, pricing, and incentives for energy conservation
5. Assess the energy audit in agricultural fields for comparative studies

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2	1					1			1		1
2	1	2	1										2	
3	1	2	1		1							3		
4	1	2	1	1								3		
5	1	2	1	3	2		1							

UNIT I **12 Hours**

ENERGY MANAGEMENT & ENERGY AUDITING

Defining Energy Management, the need for Energy Management, Energy management techniques, the importance of Energy Management, managing Energy consumption, Energy Audit and Types, and Energy Audit Instruments. understanding Energy costs, benchmarking, Energy performance, matching energy use to requirement, optimizing the input, fuel, and energy substitution, material and Energy balance diagrams, Energy pricing, Energy and Environment, and Energy Security.

UNIT II **10 Hours**

ENERGY CONSERVATION IN AGRO-BASED INDUSTRY

Energy Conservation in the Indian industrial sector, Energy saving potential in the industry: boiler, furnaces, air compressors, refrigeration systems, heat exchangers, heat pumps, turbines, electric drives, pumps, cooling towers, fans, and blowers. Energy Conservation in agriculture sector: Energy Conservation opportunities in pumps used in agriculture sector, summary.

UNIT III **9 Hours**

ENERGY-SAVING OPPORTUNITIES IN EXISTING FOOD PROCESSING

Facilities Energy Consumption pattern, Energy Conservation in Grains and Oilseeds Milling Facilities, Sugar and Confectionary Processing Facilities, Fruit and Vegetable Processing Facilities, Dairy Processing Facilities, Meat Processing Facilities, in Bakery Processing Facilities

UNIT IV **8 Hours**

FOOD PROCESSING WASTES AND UTILIZATION

Concepts of Anaerobic Digestion of Food Processing Wastes, Fermentation of Food Processing Wastes into Transportation Alcohols, Bio-diesel Production from Waste Oils and Fats, Thermochemical Conversion of Food Processing Wastes for Energy Utilization

UNIT V **6 Hours**

WASTE HEAT RECOVERY

Waste Heat Recovery and Thermal Energy Storage in Food Processing Facilities- Novel Thermodynamic Cycles Applied to the Food Industry for Improved Energy Efficiency

FOR FURTHER READING

Case studies on Energy auditing of Food industries-industry visit-report preparation and presentation by the students through PPT in the class

Total: 45 Hours

Reference(s)

1. Umesh Rathore,'energy management', Kataria publications, 2 nd ediiton,2014.
2. G Harihara Iyer , “Green Building Fundamentals”, Notion press.com 2022
3. Guidebooks for National Certification Examination for Energy Manager/Energy Auditors Book-1, General Aspects
4. Umesh Rathore, 'energy management', Kataria publications, 2nd ediiton, 2014.
5. L.Wang, Energy Efficiency and Management in Food Processing Facilities, CRC Press, 2009

21AG022 **COGENERATION AND WASTE HEAT RECOVERY SYSTEMS** **3 0 0 3**

Course Objectives

- To acquire knowledge on the various seed production and processing technologies
- To impart knowledge on seed testing and the methods
- To impart knowledge about seed certification, legislation, and industries in India

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Assess the principles of cogeneration and analyze thermodynamic power cycles
2. Evaluate the performance of cogeneration systems
3. Find the cogeneration technologies based on steam turbines, gas turbines and IC engines,
4. Organise the issues and applications of cogeneration technologies
5. Analyze the waste heat recovery systems, economic analysis, and environmental consideration

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3	2	3	2								
2	2	3	2	1	3	1								
3	1	2	3	3	1	3								
4	3	3	1	3	3	1								
5	1	3	2	2	2	1	1							

UNIT I **9 Hours**

INTRODUCTION

Cogeneration principles and definition-thermodynamics power cycle analysis-Rankine and Brayton cycles- topping and bottoming cycles

UNIT II **9 Hours**

COGENERATION SYSTEMS

Cogeneration Applications in various industries like Cement, Sugar Mill, Paper Mill, Textile, etc. Sizing of waste heat boilers - Performance calculations, Part load characteristics selection of Cogeneration Technologies – Financial considerations - Operating and Investments - Costs of Cogeneration. Impacts of cogeneration plants- fuel- electricity

UNIT III **9 Hours**

APPLICATIONS OF COGENERATION

Cogeneration Applications in various industries like Cement, Sugar Mill, Paper Mill, Textile, etc. Sizing of waste heat boilers - Performance calculations, Part load characteristics selection of Cogeneration Technologies – Financial considerations - Operating and Investments - Costs of Cogeneration. Impacts of cogeneration plants- fuel- electricity

UNIT IV **9 Hours**

WASTE HEAT SOURCES

Selection criteria for waste heat recovery technologies. Recuperators - Regenerators - Economizers - Plate Heat Exchangers - Waste Heat Boilers-Classification, Location, Service Conditions, Design Considerations, Unfired combined Cycle - supplementary fired combined cycle - fired combined cycle applications in Industries - fluidized bed heat exchangers - heat pipe exchangers - Heat pumps - types-design

UNIT V **9 Hours**

COST ANALYSIS AND ENVIRONMENTAL IMPACT OF COGENERATION SYSTEMS

Economic analysis of cogeneration and waste heat recovery systems. Regulatory and financial framework for cogeneration and waste heat recovery systems. Environmental considerations-mitigation of harmful emissions from energy production- conversion and utilization technologies-control of air, water and ground pollution

FOR FURTHER READING

Case studies on Cogeneration-visit to industries preparation and presentation by students in the class through PPT

Total: 45 Hours

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.
4. R.L Agrawal, A text book on "Seed Technology", Oxford & IBH Publication, Co Pvt Ltd, New Delhi-1992
5. L.O Copeland and M.B Mc Donald, "Principles of Seed Science and Technology", Chapman and Hall, New York, 1995.

21AG023 GREEN BUILDINGS 3 0 0 3

Course Objectives

- To imbibe the basics of green buildings and to learn guidelines for the development and certification of green designs.
- To identify various areas of implementing strategies for green design in projects to enhance the built environment.
- To impart knowledge on site selection, waste management, water, and energy efficiency, and indoor environmental quality of green buildings

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Execute the concept of green buildings and its certification
2. Assess the site selection criteria and water management in green buildings
3. Analyse the energy efficiency and use of renewable energy in green buildings
4. Select appropriate green building material and analyse waste management strategies
5. Find indoor environmental quality in green buildings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3	2	3	2								
2	2	3	2	1	3	1								
3	1	2	3	3	1	3		1						
4	3	3	1	3	3	1		1						
5	1	3	2	2	2	1	1	1						

UNIT I **9 Hours**

CONCEPT OF GREEN BUILDINGS AND ITS CERTIFICATION

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC, and LEED, overview of the criteria as per these rating systems.

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UNIT II **9 Hours**

SITE SELECTION AND WATER CONSERVATION AND EFFICIENCY

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximizing comfort by proper orientation of building facades, daylighting, ventilation, etc. Water conservation and efficiency: Rainwater harvesting methods for roof and non-roof, reducing landscape water demand by proper irrigation systems, water-efficient plumbing systems, water metering, wastewater treatment, recycle and reuse systems

UNIT III **9 Hours**

ENERGY EFFICIENCY AND USE OF RENEWABLE ENERGY IN GREEN BUILDINGS

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy, and life cycle energy. Methods to reduce operational energy: Energy-efficient building envelopes, efficient lighting technologies, energy-efficient appliances for heating and air-conditioning systems in buildings, zero ozone-depleting potential (ODP) materials, wind and solar energy harvesting, energy metering, and monitoring, the concept of net zero buildings.

UNIT IV **9 Hours**

WASTE MANAGEMENT AND BUILDING MATERIALS USED IN GREEN BUILDINGS

Building materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, and stabilized mud blocks, (c) use of materials with recycled content such as blended cement, pozzolana cement, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management.

UNIT V **9 Hours**

INDOOR ENVIRONMENTAL QUALITY

Indoor Environmental Quality for Occupant Comfort and Wellbeing: Daylighting, air ventilation, exhaust systems, low VOC paints, materials & and adhesives, and building acoustics. Heating and cooling - Codes related to green buildings: NBC, ECBC, ASHRAE, UPC, etc.

FOR FURTHER READING

Study about the certification process and standards of the materials

Total: 45 Hours

Reference(s)

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
3. Alternative building materials and technologies by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. Non-Conventional Energy Resources by G. D. Rai, Khanna Publishers.

5. Sustainable Building Design Manual, Vol.1 and 2, TERI, New Delhi 2004.
6. Mike Montoya, Green Building Fundamentals, Pearson, USA, 2010
7. Charles J. Kibert, Sustainable Construction – Green Building Design and Delivery, John Wiley & Sons, New York, 2008.
8. Regina Leffers, Sustainable Construction and Design, Pearson / Prentice Hall, USA, 2009

21AG024 ENERGY STORAGE SYSTEMS 3 0 0 3

Course Objectives

- To understand the necessity of different energy storage systems
- To study details of various energy storage systems along with applications
- Enabling to identify the optimal solutions to a particular energy storage application/utility

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Execute need of energy storage systems
2. Find knowledge pertaining to various ways of thermal energy storage, its analysis and use
3. Find knowledge pertaining to various ways of chemical energy storage, its analysis and use
4. Assess knowledge pertaining to various ways of electromagnetic and mechanical energy storage, its analysis and use
5. Assess knowledge pertaining to various ways of electrochemical energy storage, its analysis and use

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2	1					1			1		1
2	1	2	1										2	
3	1	2	1		1							3		
4	1	2	1	1								3		
5	1	2	2	2	2	1			1			3		

UNIT I **9 Hours**

OVERVIEW OF ENERGY STORAGE SYSTEMS

Energy storage systems overview - Scope of energy storage, needs, and opportunities in energy storage, Technology overview and key disciplines, comparison of the time scale of storages and applications, Energy storage in the power and transportation sectors. Importance of energy storage systems in electric vehicles, Current electric vehicle market.

UNIT II **9 Hours**

THERMAL ENERGY STORAGE SYSTEMS

Thermal storage system, heat pumps, hot water storage tank, solar thermal collector, application of phase change materials for heat storage-organic and inorganic materials, efficiencies, and economic evaluation of thermal energy storage systems

UNIT III **9 Hours**

CHEMICAL ENERGY STORAGE SYSTEMS

Chemical storage system- hydrogen, methane, etc., concept of chemical storage, application of chemical energy storage system, advantages and limitations of chemical energy storage, challenges, and future prospects of chemical storage systems.

UNIT IV **9 Hours**

ELECTROMAGNETIC AND MECHANICAL ENERGY STORAGE SYSTEMS

Electromagnetic storage systems - double layer capacitors with electrostatically charge storage, superconducting magnetic energy storage (SMES), concepts, advantages and limitations of electromagnetic energy storage systems- Mechanical-Pumped hydro, flywheels, and pressurized air energy storage

UNIT V **9 Hours**

ELECTROCHEMICAL STORAGE SYSTEMS

Indoor Environmental Batteries - Working principle of battery, primary and secondary (flow) batteries, battery performance evaluation methods, major battery chemistries, and their voltages- Li-ion battery& Metal hydride battery vs lead-acid battery. Supercapacitors - Working principle of the supercapacitor, types of supercapacitors, cycling, and performance characteristics, the difference between battery and supercapacitors, Introduction to Hybrid electrochemical supercapacitors

FOR FURTHER READING

Study the advances in energy storage technology

Total: 45 Hours

Reference(s)

1. Energy Storage - Technologies and Applications by Ahmed Faheem Zobaa, InTech.
2. Fundamentals of Energy Storage by J. Jensen and B. Sorenson, Wiley-Interscience, New York,
3. Handbook of battery materials by C. Daniel, J. O. Besenhard,Wiley VCH Verlag GmbH & Co. KgaA
4. Electric & Hybrid Vehicles by G. Pistoia, Elsevier B. V.
5. Thermal energy storage: Systems and Applications by Dincer I. and Rosen M. A., Wiley pub.
6. Energy Storage: Fundmentals, Materials and Applications, by Huggins R. A., Springer
7. Fuel cell Fundamentals by R. O'Hayre, S. Cha, W. Colella and F. B. Prinz, Wiley Pub.
8. Chemical and Electrochemical Energy System by R. Narayan and B. Viswanathan, University Press.
9. Battery Systems Engineering by C. D. Rahn and C. Wang, Wiley Pub.
10. Electrochemical Energy Storage for Renewable sources and grid balancing by P. T. Moseley and J. Garche, Elsevier Science
11. Compressed air energy storage by F. P. Miller, A. F. Vandome, M. B. John, VDM publishing.

21AG025 CDM AND CARBON TRADING TECHNOLOGY 3 0 0 3

Course Objectives

- To know the basics and importance of clean development mechanism (CDM)
- To monitor CDM for sustainable development and know about carbon credit
- To know the concept of carbon trading

Programme Outcomes (POs)

a. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

b. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

c. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

d. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

e. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Execute the effects of greenhouse gas emission and explain the responsibilities of countries in GHG emission
2. Find the Kyoto Protocol and develop clean development mechanism (CDM) projects
3. Execute the features of CDM and employ monitoring and auditing techniques on CDM projects
4. Develop guidelines for small-scale and Land Use, Land Use Change, and Forestry (LULUCF) CDM projects
5. Compare the alternate techniques for lowering carbon emission

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2	1					1			1		1
2	1	2	1										2	
3	1	2	1		1							3		
4	1	2	1	2								3		
5	1	2	2	2	2	1			1			3		

UNIT I **9 Hours**

GREEN HOUSE GASES AND ENVIRONMENTAL CHANGE

Global Environmental Changes-United nations framework convention on climate change-United (UNFCC)-ozone layer depletion -land degradation-air and water pollution-sea-level rise-loss of biodiversity-climatic change problem GHG emissions by different countries-developing country responsibilities - India's Greenhouse gas emissions - Conference of parties

UNIT II **9 Hours**

KYOTO PROTOCOL AND CDM PROJECTS

Kyoto protocol and clean development mechanism-CDM and cooperative mechanism-CDM overview administration -participation-CDM institutions-procedures CDM project cycle-project design and formulation - eligibility-additionally. Approval of (DNA) Designated National Authority. Validation and registration-monitoring-validation and certification through the source of Certified Emission Reduction (CER)

UNIT III **9 Hours**

TYPES AND FEATURES OF CDM

Types of CDM topologies -project activity -small-scale CDM project categories- access station and cater station projects. PDO- project design document -General description of project activity-baseline methodology-monitoring methodology-auditing period-technical aspects

.

UNIT IV **9 Hours**

MONITORING OF CDM

Monitoring and verification-verification process principles of verification-report preparation-pitfalls. Joint implementation (JI)-institutions and procedures-guidelines-JI or small-scale projects-JI Land Use, Land Use Change and Forestry (LULUCF) projects

UNIT V **9 Hours**

SUSTAINABLE ENERGY DEVELOPMENT

Low carbon technologies-low carbon building-alternative approaches-energy efficiency projects-sustainable energy policy concepts-mitigating energy-related GHG emissions through renewable energy-carbon trading

FOR FURTHER READING

Study the policies and protocol for carbon trading

Total: 45 Hours

Reference(s)

1. CDM Manual for project developers and policy makers-UNFCCC Publication, 2007
2. Myungkyoon Lee, Information and Guide Book - the UNEP project CD4CDM-UNEP publication, June 2004.
3. MyungKyoon Lee, Baseline Methodologies for clean Development Mechanism Projects- A Guide Book-Vol.1, UNEP publication, 2005
4. MyungKyoon Lee, Baseline Methodologies for clean Development Mechanism Projects- A Guide Book-Vol.2, UNEP publication,2005
5. Aukland L, Bass S, Hug S, Landell Mals N, Tipper R, Laying the Foundations for clean Development, Preparing the Land use sector London, 2002
6. Carbon sequestration in dryland soils, World Soil Resources report No.102, Food and Agriculture Organization, Rome,2004

22AG026 SOIL FERTILITY AND NUTRIENT MANAGEMENT 3 0 0 3

Course Objectives

- To enhance the knowledge on soil fertility and soil formation processes.
- To impart knowledge on essential nutrients and its movements in soil-plant.
- To study the transformation of nutrients and its formation and functions.
- To study the manures and fertilizers application for the improvement of soil fertility.
- To analyze the soil and plant samples for better crop production.

Course Outcomes (COs)

1. Determine the classification of soil and land capability, soil erosion and its control
2. Assess the functions and nutrients supply from soil to plant
3. Find nutrient transformation in relation to soil-plant systems
4. Determine the manure and fertilizers for crop production
5. Check the soil fertility by conducting the soil tests using different methods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1				2		1			3	1		
2		3	1		1				1			2	2		1
3			1	1								1	1		2
4		1	3										2		1
5		1	3										2		3

UNIT I **10 Hours**

SOIL AS A NATURAL RESOURCE

Definition of Soil-Soil Fertility and Soil Productivity-soil formation process-soil & land capability classification-soil acidity and alkalinity- soil erosion and its control- soil organisms-organic matter-modern views of humus formation -Plant Growth & Response Curves-liebig's law of minimum-Mitscherlich's law.

UNIT II **9 Hours**

BASIC SOIL-PLANT RELATIONSHIPS

Essential plant nutrients- Definition of macro and micro nutrients -Functions and deficiency symptoms- Hidden hunger- Beneficial elements -Criteria of essentiality of elements- Luxury consumption of nutrients-SUPPLY OF NUTRIENTS FROM organic matter-movement of ions from soils to roots -Mass flow-diffusion-root interception-nutrient mobility in soil- ion absorption by plants.

10 Hours

UNIT III

NUTRIENT TRANSFORMATION IN RELATION TO SOIL-PLANT SYSTEMS

The functions and forms of N, P, K in soil -Biological N2 fixation - losses of nitrogen from soils-leaching - denitification- forms of P in soil- P sources- Factors affecting K availability- sulfur, calcium and magnesium-cycle-forms and functions in plants.

UNIT IV **8 Hours**

MANURES AND FERTILIZERS

Definition- characteristics of manure -classification-sustainable agriculture- composts-methods of composting- organic farming-LEISA-fertilizer-classification-recommendations in agriculture crops - Calculation and application of fertilizers in soil -Nano fertilizer-soil testing and its importance.

UNIT V **8 Hours**

SOIL FERTILITY EVALUATION AND MAINTENANCE OF SOIL HEALTH

Characteristics of a healthy soil -Measure of soil health-soil health indicators-soil health report-problem soils –Plant analysis- total analysis, rapid tissue test, enzyme test, DRIS method and critical levels of nutrients in plants-problem due to excessive use of chemical fertilizers-crop residue management.

FOR FUTHRE READING

Agricultural productivity and environmental quality-economics of nutrient use-soil and water pollution-Study of soil profile- identification of different soil types- interpretation of soil and water test data.

Total: 45 Hours

Reference(s)

1. John L.Halvin, Samuel.L.Tisdale, Werner.L.Nelson, James.D.Beaton, Soil fertility and fertilizers, an introduction to nutrient management, Eighth edition, PEARSON India education services, 2017.
2. Dilip Kumar Das, Introductory Soil Science, 3rd Edition, Kalyani Publishers, Ludhiana, 2013.
3. T.D. Biswas and S.K. Mukherjee, Text Book of Soil Science, 2nd Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2001.
4. Indian Society of Soil Science, Fundamentals of Soil Science, ISSS Publication, IARI, New Delhi, 2012.
5. E-Course: Indian council of Agricultural Research.

21AG027 PLANT PROTECTION 3 0 0 3

Course Objectives

- To impart basic knowledge of insect pest and diseases and their losses caused to crops.
- To study various methods of plant protection to get more yield in Agricultural and Horticultural crops
- To gain knowledge on pest & diseases management in horticultural crops

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member
and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Assess knowledge on various groups of insect pests and diseases of crops and their symptoms of damage
2. Assess knowledge on different crops damaged by insects and diseases
3. Assess knowledge on various methods of pest management to increase crop yield.
4. Assess knowledge on plant protection machineries.
5. Execute pesticide residues and health hazards; integrated pest and disease management in organic/inorganic farming.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			1	3								3		
2			2	1	1		2	1			2	3		
3			2	2	2		2	1	2			3		
4			2	2	2		2		2	1		3		
5				2	1		2	2	2			2		

UNIT I **9 Hours**

GROUPS OF INSECTS AND DISEASE

Sucking pests, borer pests, soil pests, Vectors, Rodent pests and their symptoms of damage. Fungal bacterial and viral pathogens causing crop diseases.

UNIT II **9 Hours**

AGRICULTURE AND HORTICULTURE CROP PESTS

Insect Pests of Agricultural crops- Rice, pulses cotton, sugarcane, Horticultural crops- Coconut, fruits, vegetables and flower crops affected by various pests and diseases. Storage insects – distribution, host range, bio-ecology, injury, integrated management of important insect pests.

UNIT III **9 Hours**

METHODS OF CROP PROTECTION

Cultural, physical, mechanical, legal, biological, chemical and biotechnological methods of crop protection, IPM, Organic farming - Organic production requirements; Biological intensive nutrient management-organic manures, vermicomposting, green manuring.

UNIT IV **9 Hours**

PLANT PROTECTION APPLIANCES

Different machineries available for spraying/soil application on annual and perennial crops and maintenance of machineries

UNIT V **9 Hours**

PESTICIDE HAZARDS AND MANAGEMENT

Pesticide residues in consumable crop parts by way of application of pesticides/fungicides, methods of decontamination of toxic chemicals, organic healthy way of crop protection

FOR FURTHER READING

Mode of spread of pest and diseases, prophylactic measures to manage pests mode of action of pesticides, complex problems in plant protection

Total: 45 Hours

Reference(s)

1. Dhandapani, N and S.Uthamasamy 2000. Integrated pest Management. Tnau Publications, Coimbatore.p.181.
2. Ragupathy. A and R. Ayyasamy 2003. A Guide on crop pests. Namrutha publications, Madananadapuram, Porur, Chennai-16.p.368
3. Justin. K.2004. Crop protection. TNAU, Petchipaarai, kanyakumari Dt.p.379.
4. K.Justin. Crop Protection. TNAU, Petchipaarai, Kanyakumari Dt.2004.

5. David, B.V. and T. kumaraswami 1975. Elements of Economic Entomology. Popular Book Depot, Chennai-600034.p.507. 16. 2003

21AG028 EXTENSION METHODOLOGY AND TRANSFER OF TECHNOLOGY 3 0 0 3

Course Objectives

- To familiarize with proper communication techniques
- To expose the students to different extension teaching methods
- Utilizing all the electronic media for transfer of technology

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Find the way to Communicate in proper channel
2. Organize the various extension teaching methods and communication gadgets
3. Execute the use of electronic media for transfer of technology
4. Execute the way of Strengthen to build experiential learning
5. Determine to able to participate in all extension activities

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1	1		1	2		2	3		1		
2		1	1	1			2		3	2		1		
3	1	1		1	3	2			3			2		
4		1		1	2	1		2		3		1		
5	1			1	2				2	3		2		

UNIT I **9 Hours**

COMMUNICATION

Communication meaning, definition, types; Communication models (Aristotle, Shanon-Weaver, Berlo, Schramm, Leagans, Rogers & Shoemaker) elements and their characteristics; Barriers in communication. Transfer of technology - meaning and concepts. Systems of transfer of technology - Knowledge Generating System (KGS) - Knowledge Disseminating System (KDS) - Knowledge Consuming System (KCS)

UNIT II **9 Hours**

EXTENSION TEACHING METHODS

Extension teaching methods, meaning, definition, functions, classification (individual, group, mass contact methods), merits and demerits; Audio aids, Visual aids and Audio-Visual aids, definition, classification, purpose, planning, selection, combination, use; Training, definition, types, training functions of FTC, KVK, EEI, MANAGE, NAARM.

UNIT III **9 Hours**

E-EXTENSION

e-Extension, Community Radio, Internet, cyber cafes, video and teleconferencing, Interactive Multimedia Compact disk (IMCD), Agri portals, Information Kiosks, Kisan Call Centre (KCC), Mobile phone, Expert System, Village Knowledge Centre (VKC), DEMIC, consultancy clinics, Geographical Information System (GIS); Agricultural journalism (Print media), definition, principles, importance, ABC of news, types of news.

UNIT IV **9 Hours**

EXPERIENTIAL LEARNING, SYSTEMS THINKING

Experiential Learning (EL), concept, three types of learning (Scientia, Techne & Praxis), Kolbs Cycle; Systems Thinking: concept, importance, Hard System vs. Soft System, Four World Views; Modelling the Farm System: production system, human activity system, marketing system, natural resource system, management system, Supra systems.

UNIT V **9 Hours**

PARTICIPATORY EXTENSION, DIFFUSION OF INNOVATIONS

Participatory Extension Approaches: RRA, PRA; Diffusion of Innovations: definition, elements; Innovation: definition, attributes; Adoption: meaning, steps in adoption process, adopter categories, factors influencing adoption of innovations; Consequences of innovations

FOR FURTHER READING

The Challenger case study: Bhopal Gas Tragedy: The Three Mile Island and Chernobyl case studies: Fundamental Rights, Responsibilities and Duties of Indian Citizens: Sample code of ethics like IETE, ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management.

Total: 45 Hours

Reference(s)

1. Berlo, D.K. 1960. The Process of Communication. Holt, Rinehart and Winston, New York.

2. Dass, R. 1981. Appropriate Technology – Percepts and Practices. Vintage Press Inc., New York.
3. Ray, G.L. 1991. Extension Communication and Management. Kalyani Publishers, Kolkata.
4. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2014
5. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
6. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi, 2006.
7. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 2004.
8. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.

21AG029 AGRICULTURAL MARKETING 3 0 0 3

Course Objectives

- To expose the students to know about marketing the Agricultural products from the point of production to the point of consumption / utilization
- To import knowledge on marketing strategies and functions
- To possess the knowledge on export and import market functioning system

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Predict, the market conduct and functions
2. Compare with various market channels and prices
3. Assess marketing institutions with various parameter
4. Assess the Agricultural products trading
5. Implement the product prices and risk management

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1	3	2	1	2	2	1	2	2	1		
2		1	1	3	2	1		1	2	3	2	1		
3		1	2	2	3	1		2	2	2		2		
4		1	2	3	2									
5		1	1	2	3	1		1	2	2	2	1		

UNIT I **9 Hours**

MARKET STRUCTURE CONDUCT AND PERFORMANCE

Components: Dynamics of Market Structure, Agricultural Marketing and Economic Development, Marketing Functions and their Classification, Marketing Agencies: Producers, Middlemen, Retailers, Commission Agents, Brokers, Advertising Agency: Marketing Institutions.

UNIT II **9 Hours**

MARKETING CHANNELS, MARKETING COST, MARKETING EFFICIENCY AND MARKET INTEGRATION

Marketing Channels: Factors affecting Marketing Channels; Marketing Channels for various products, Innovative Marketing Channels, Market Integration: Types, Marketing Cost in India, Reducing Marketing Cost, Relationship of Farmer"s Price and Consumer"s Price

UNIT III **9 Hours**

COOPERATIVE AGRICULTURAL MARKETING INSTITUTIONS

Functions: Types, Single Commodity Multi Commodity, Multi purpose, Multi commodity Structure; Membership: Sources of Finance, Functioning, Cooperative Processing, NAFED, NCDC, NDDB, TANFE

UNIT IV **9 Hours**

EXTERNAL TRADE IN AGRICULTURAL PRODUCTS

Trade Policy for Agriculture: Share of Agricultural Products in Total Imports/Exports of India, Changes in India"s Agricultural Export Basket, Recent Policies on Trade, GATT (The General Agreement on Trade and Tariffs), World Trade Organization (WTO).

UNIT V **9 Hours**

AGRICULTURAL PRICES AND RISK MANAGEMENT

Commission for Agricultural Costs and Prices (CACP): Price Policy, risks-minimization of risk, Future Trading, Dangers of Forward Market, Contract Farming/Contract Marketing

FOR FURTHER READINGFOR FURTHER READING

Case studies on regulated markets for agricultural commodities

Total: 45 Hours

Reference(s)

1. Acharya S.S and N.L. Agarwal. 2012. Agricultural marketing in India. Oxford and Ibh publishing co.pvt.Ltd., New Delhi
2. Agricultural Marketing in Tamil Nadu, Department of Agricultural Marketing,Government of Tamil Nadu, Chennai, 2000.
3. Khols, R.L. and Damey, Marketing of Agricultural Products, McMillan Company, New York, 1972.

4. Wader, L.K. 2013.Text Book Of Agricultural Marketing And Cooperation. ICAR New Delhi
5. www.agriwatch.com www.icar.org.in / en / agricultural - extension.html www.gropedia.iitk.ac.in www.agricoop.nic.in www.agmarknet.nic.in

21AG031 SUSTAINABLE AGRICULTURE AND FOOD SECURITY 3 0 0 3

Course Objectives

- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability
- Importance of science, food security and ecological balance

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Implement the need for sustainable agriculture and land utilization
2. Assess the need for irrigation potential and water resource sustainability
3. Demonstrate organic farming and different sustainable agricultural practices
4. Analyze the ecological balance in food production and nutritional food security
5. Determine the policies and programmes for sustainable agriculture and food security

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2				1								1
2	2	2	3			1								1
3	2	2	3	1		1								2
4	2	3	2											2
5	2						2	3						2

UNIT I **9 Hours**

LAND RESOURCE AND ITS SUSTAINABILITY

Sustainable agriculture- definition, concept, goals; factors affecting ecological balance- land degradation, water and air pollution, global warming, impact and amelioration. Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture. Land Resources of India - Population and land, Land utilization, Net Area Sown, changes in cropping pattern, land degradation

UNIT II **9 Hours**

WATER RESOURCE AND ITS SUSTAINABILITY

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 **9 Hours**

SUSTAINABLE AGRICULTURE & ORGANIC FARMING

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. Sustainable agriculture practices-natural farming, alternative farming, integrated farming

UNIT IV **9 Hours**

FOOD PRODUCTION AND FOOD SECURITY

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. Food security - Concepts and definitions, agriculture and food security, nutrition and health urbanization and food security, food systems and food security. Sustainable food security indicators and index – Indicator of sustainability of food Security – Path to sustainable development

UNIT V **9 Hours**

POLICES AND PROGRAMMES FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY

HEIA, LEIA and LEISA and its techniques for sustainability, Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages. 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 – Macroeconomic policies Employment and cash income, markets and food prices

FOR FURTHER READING

Precision Agriculture, Integrated Farming System, Bio-farms, Global Positioning System (GPS), Geographic Information System (GIS), Site Specific Nutrient Management (SSM) for nutrient and irrigation management practices

Total: 45 Hours

Reference(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
3. Sithamparanathan, J., Rengasamy, A., Arunachalam, N. Ecosystem principles and sustainable agriculture, Scitech Publications, Chennai, 1999
4. Gangadhar Banerjee and Srijeet Banerji, Economics of sustainable agriculture and alternate production systems, Ane Books Pvt Ltd., 2017
5. M. S. Swaminathan, Science and sustainable food security, World Scientific Publishing Co., Singapore, 2010
6. Mohan, S., Nair, P.K.R., Long, A.J. 2007. An Assessment of Ecological Diversity in Homegardens: A Case Study from Kerala State, India. Journal of Sustainable Agriculture. Volume 29, Issue 4: 135-153
7. Bhatia MS. (1991). Agricultural Statistics at a Glance. Ministry of Agriculture, Govt. of India, New Delhi

21AG032 **INSTRUMENTATION AND CONTROL ENGINEERING IN AGRICULTURE** **3 0 0 3**

Course Objectives

- To expose students with electrical and electronic components used in the analytical instruments
- To learn and understand the principles and operation of different instrumentation techniques.
- To understand the basic concepts of open loop and closed loop control systems.
- To understand the concept of frequency domain analysis.
- To understand the concept of stability of a system.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
f. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
g. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Organize the function of electrical and optical component in analytical instruments and their calibration
2. Execute the spectroscopic techniques to identify, estimate and characterize analytes
3. Organize the thermal behaviour of materials using thermal analysis
4. Develop a mathematical model of a physical system and compute the transfer function using Block diagram reduction technique and Signal flow graph.
5. Assess the performance of first and second order system and compute the steady state error for different test signals

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2	1	1	1						1	1
2	2	2	2	1	2	1	1						1	
3	1	3	3	1	1	1	2							1
4	2	2	2	1	1	1	2	1					2	
5	2	3	3	1	2	1	1		1	1				

UNIT I **9 hours**

INTRODUCTION

Basic concepts of measurement system configuration. Concept of accuracy, precision error, resolution repeatability bias, calibration, range; Performance characteristics of Instruments- Zero, first and second order instrument systems and their response to different input signals (step, ramp etc) Specification and testing of dynamic response.

UNIT II

INSTRUMENT FOR VARIOUS USES **9 hours**

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

UNIT III

INTRODUCTION TO CONTROL SYSTEM **9 hours**

Control system characteristics, purpose disturbances and stability Feed back and feed forward control strategies. Modelling the Dynamic and Static Behaviour of Process- Mathematical modelling for physical process control, state variables and state equations, modelling difficulties and considerations. Input-output models block diagram, degree of freedom, process controllers action, P, PI, PID controllers, final control system.

UNIT IV

ANALYSIS OF DYNAMIC BEHAVIOUR **9 hours**

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

UNIT V

QUALITATIVE ANALYSIS OF RESPONSE OF SYSTEM **9 hours**

Design of Feed Back System Block diagram, stability analysis, frequency response root locus analysis, Routh's criteria, Nyquist plots and Bode diagrams. Control Systems for Various Uses Electronic pneumatic, hydraulic control system and their application in Farm machinery, food processing industry aquaculture, milk processing.

Total: 45 Hours

Reference(s)

1. Doeblin, D.O. "Measurement Systems; Application and Design". McGraw Hill, 1984.
2. Considine T..M. "Process/Industrial Instruments and Controls· Handbook", McGraw Hill 1993.
3. Fribance, A.E. "Industrial Instrumentation Fundamentals", McGraw Hill, 1962.
4. Coughanowr, D.R. "Process Systems Analysis and Control", McGraw Hill, 1991.
5. Patranabis. D. "Principles of Industrial Instrumentation", Tata McGraw Hill, 1995.
6. Patranabis, D. "Principles of Process Control", Tata McGraw Hill, 1995.

21AG033 **DATABASE MANAGEMENT SYSTEM AND MICROPROCESSORS APPLICATIONS** **3 0 0 3**

Course Objectives

- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques
- Impart knowledge on the methods of interfacing 8085 and 8086 microprocessors with various peripheral devices

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
f. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
g. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Assess to Install, configure, and interact with a relational database management system
2. Assess to master the basics of SQL and construct queries using SQL
3. Organize the modes of operations of I/O interface devices
4. Develop programs using the register set and instruction set of Programmable Interrupt Controller 8259A
5. Develop programs using the register set and instruction set of 8051 microcontrollers

Articulation matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	2	1	2	1						1	1
2	1	2	3	2	2	1	1							
3	2	2	2	1	1	1	2							2
4	3	3	2	1	2	1	2	1					2	
5	1	2	3	1	1	2	1		1	1				

UNIT - I **9 hours**

INTRODUCTION

Purpose of Database System - Views of data – data models, database management system, three-schema architecture of DBMS, components of DBMS. E/R Model - Conceptual data modeling - motivation, entities, entity types, attributes, relationships, relationship types, E/R diagram notation, examples.

UNIT – II

RELATIONAL MODEL **9 hours**

Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL

UNIT – III

Database Design **9 hours**

Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF

UNIT-IV **9 hours**

PERIPHERAL DEVICES AND I/O INTERFACING

Programmable Interrupt Controller 8259A: Architecture and Signal Descriptions of 8259A – Command Words of 8259A - Operating modes of 8259A - The Keyboard/Display Controller 8279: Architecture and Signal Descriptions of 8279 - Modes of Operation of 8279 - DMA Controller 8257: Internal Architecture and Signal Descriptions of 8257 - DMA Transfers and Operations.

UNIT – V **9 hours**

MICROCONTROLLER

Architecture of 8051 - Signal Descriptions of 8051 - Register Set of 8051 - Memory Addressing - External I/O Interfacing - Addressing modes of 8051 - Instruction Set of 8051.

FOR FURTHER READING

Introduction to Parallel, Distributed and Object Oriented Databases- Introduction to MySQL and PHP.

Total: 45 Hours

Reference(s)

1. A. Silberschatz, Henry F. Korth, and S. Sudharshan, “Database System Concepts”, 5th Ed, Tata McGraw Hill, 2006.
2. C. J. Date, A. Kannan and S. Swamynathan, “An Introduction to Database Systems”, 8th ed, Pearson Education, 2006Raghu Ramakrishnan, “Database Management Systems”, Third Edition, McGraw Hill, 2003.
3. S. K. Singh, “Database Systems Concepts, Design and Applications”, First Edition, Pearson Education, 2006.
4. Mohamed Ali Mazidi, Janice Gillispie Mazidi, The 8051 microcontroller and embedded systems, Pearson education, 2009.

21AG034 DATA ANALYTICS IN AGRICULTURAL SYSTEMS 3 0 0 3

Course Objectives

- Familiarize with the fundamentals of data science and related concepts
- Acquaint the students with the knowledge to construct complex statistical models, assess the fit of such models to the data, and apply the models in real-world contexts
- Apply quantitative modelling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Select the Implement data science fundamentals and apply them to day-to-day business and industrial needs
2. Assess appropriate probability and statistical tests using R
3. Execute supervised and unsupervised algorithms in the data analysis process

4. Design the mathematical models for data analysis and also perform mining in text data
5. Construct the visualization models using Tableau and d3.js tools

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2	1	3	2	2						2	1
2	2	3	1	1	1	2	2							
3	2	2	1	2	2	2	1							1
4	3	2	1	2	3	3	1						1	
5	2	3	2	1	1	2	3							

UNIT I **7 Hours**

INTRODUCTION TO DATA SCIENCE

Data Science Fundamentals, Exploring data engineering pipelines, Applying data science and data warehousing to business and industry

UNIT II **9 Hours**

INTRODUCTION TO PROBABILITY AND R

Introduction to Probability, Conditional Probability, Random Variable, Statistical Modelling, Probability Distribution, R Introduction, Data Structures in R, Working with Data in R

UNIT III **10 Hours**

SUPERVISED AND UNSUPERVISED LEARNING

Linear Regressions, Classification- Decision Tree, Naive Bayes, K-Nearest Neighbors, Clustering- Identifying Clusters, K-Means Clustering, Hierarchical Clustering

UNIT IV **10 Hours**

MATHEMATICAL MODELLING

Association Rule Mining, Time Series Analysis, Dimensionality Reduction, Principal Component Analysis, Linear Discriminant Analysis, Sentiment Analysis on text data

UNIT V **9 Hours**

VISUALIZATION TOOLS

Introduction to Visualization - Types of visualizations, Working with Tableau, Creating views in Tableau, using d3.js for data visualization

FOR FURTHER READING

Data Analysis using Python, Natural Language Processing, Google Charts.

Total: 45 Hours

Reference(s)

1. Lillian Pierson, Data Science for Dummies, John Wiley,2015
2. Garrett Grolemund, Hadley Wickham, R for Data Science, O Reilly in January 2017.
3. Andrie de Vries, Joris Meys, R For Dummies, John Wiley and Sons, 2012.
4. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, Elsevier Inc., 2012.
5. David Baldwin , Mastering Tableau, Packt Publishing, 2016.

21AG036 MECHATRONICS IN AGRICULTURAL ENGINEERING 3 0 0 3

Course objectives

- Develop a comprehensive understanding of mechatronics principles and their application in agricultural engineering
- To learn about mechatronics systems and equipment used in agricultural engineering
- To Analyze and design mechatronics solutions for agricultural engineering problems
- Develop critical thinking and problem-solving skills in the context of mechatronics in agricultural engineering

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Assess the mechatronic design approach to develop integrated systems in the field of agricultural engineering
2. Design the effective interfacing, instrumentation, and control systems for mechatronic applications in agricultural engineering
3. Assess the principles of Microprocessor based controllers and Microelectronics
4. Organize various control systems and their application in agricultural engineering
5. Execute the knowledge to choose suitable robot used for the agriculture purpose.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2				1								3
2	2	2	3			1								3
3	2	2	3	1		1								3
4	2	3	2											3
5	2						2	3						3

UNIT - I **9 hours**

INTRODUCTION

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

UNIT – II **9 hours**

MICROPROCESSOR CONTROL

System interfacing, instrumentation, and control systems. Input/output signals of a mechatronic system, signal conditioning, microprocessor control, microprocessor numerical control, microprocessor input/output control.

UNIT – III

MICROPROCESSOR BASED CONTROLLERS AND MICROELECTRONICS **9 hours**

Introduction to microelectronics, digital logic, overview of control computers, microprocessors and microcontrollers, programmable logic controllers, digital communications.

UNIT-IV **9 hours**

TECHNOLOGIES OF ROBOT

Sub systems, transmission system (Mechanics), power generation and storage system, sensors, electronics, algorithms and software. Servo motor drives types and applications. Stepper motor and its concept. Industrial robots: Classification and sub systems. Defining work space area.

UNIT – V **9 hours**

APPLICATION OF ROBOTS IN AGRICULTURE

Harvesting and picking, weed control, autonomous mowing, pruning, seeding, spraying and thinning, phenotyping, sorting and packing. Utility platforms. Use of different agro bots in agriculture.

FOR FURTHER READING

System modelling & control, Mathematical Models, Engineering Systems, Electro-mechanical & Hydraulic-mechanical Systems

Total: 45 Hours

Reference(s)

1. Alciatore DG and Histand MB. 2002. Introduction to Mechatronics and Measurement System. McGraw Hill Pvt Limited, New Delhi.
2. Robert HB. 2002. Mechatronic Hand Book. CRC Press.
3. Shakhatreh and Fareed. 2011. The Basics of Robotics. Lahti University of Applied Sciences Machine and Production Technology.
4. Wolfram, Stadler. 1995. Analytical Robotics and Mechatronics. McGraw Hill Pvt Limited, New Delhi.
5. Bolton, W. 2010. Mechatronics. Pearson Education Asia

21AG037 GEOINFORMATICS AND NANO TECHNOLOGY 3 0 0 3

Course Objectives

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Organize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Assess the characterization techniques for analyzing nanomaterials
4. Execute the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	2	2	1							1	1
2	2	2	1	1	2	3								
3	2	1	2	1	2	2								2
4	3	1	3	1	3	2							2	
5	2	3	1	2	2	3								

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- quantum cascade laser - quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-HEMT devices: structure, fabrication, principle, types and applications - organic LED: basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- single electron transistor - particulate and geometrical nanomagnets - spintronics

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, Aulice Scibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

21AG038 AGRI BUSINESS MANAGEMENT AND ENTERPREUSHIP

3 0 0 3

Course Objectives

- 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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

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

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1						1	2		3			
2	1	2	1		1				1		1			
3		1	2	1		1	3	3			1			
4		1	2		1	1								
5	1	2	1	1				2						

UNIT I **9 Hours**

AGRIBUSINESS MANAGEMENT

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 **9 Hours**

MANAGEMENT FUNCTIONS

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 **9 Hours**

FUNCTIONAL AREA - I

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

UNIT IV **9 Hours**

FUNCTIONAL AREA - II

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

UNIT V **9 Hours**

ENTREPRENEURSHIP

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

FOR FURTHER READING

Market survey for understanding client needs and satisfaction - Pricing methods for small agribusinesses

Total: 45 Hours

Reference(s)

1. Subba Reddy, S. and P. Raghu Ram. 2011. Agricultural Finance and Management. Oxford & IBH. New Delhi.
2. Muniraj, R. 1987. Farm Finance for Development. Oxford & IBH. New Delhi.
3. Lee, W.F., M.D. Boehlje, A.G. Nelson and W.G. Murray. 1998. Agricultural Finance.Kalyani Publishers. New Delhi
4. Patnaik, V.E. and A.K. Roy. 1988. Cooperation and Cooperative Management. Kalyani Publishers, Ludhiana.

21AG039 AGRICULTURAL FINANCE, BANKING AND COOPERATION

3 0 0 3

Course Objectives

- To study the various methods of agriculture finance
- To reconstruct the policies and of co-operative so that it can bring about economic development of people

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
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f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Create a confidence in the preparation and use of business accounts
2. Compute an opportunity to prepare, as part of their final management project, a thorough analysis of a business situation
3. Implement the marketing linkages with centre to increase employment opportunities and generating income
4. Execute Co-operation Philosophy and Principles as part of revitalizing co-operative credit
5. Predict the financial inclusion and exclusion with assessment of crop losses.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1								3			
2	2	1	1	1	1	1					3			
3	3	2	1		1	1	2	1			2			
4	2	1	1	1	1	1					3			
5	2	1	1	1	1	1					3			

UNIT I **9 Hours**

AGRICULTURAL FINANCE - NATURE AND SCOPE

Agricultural Finance: Definition, Importance, Nature and Scope - Agricultural credit: Meaning, Definition, Need and Classification - Sources of credit - Role of institutional and non - institutional agencies - Rural indebtedness: Consequences of rural indebtedness Development of rural credit in India

UNIT II **9 Hours**

FARM FINANCIAL ANALYSIS

Principles of Credit - 5Cs, 3Rs and 7 Ps of Credit - Project Cycle and Management - Preparation of bankable projects / Farm credit proposals - Feasibility - Time value of money: Compounding and Discounting - Appraisal of farm credit proposals - Undiscounted and Discounted measures - Repayment plans - Farm Financial Statements: Balance Sheet, Income Statement and Cash Flow Statement - Financial Ratio Analysis

UNIT III **9 Hours**

FINANCIAL INSTITUTIONS

Institutional Lending Agencies - Commercial banks: Nationalization, Agricultural Development Branches-Regional Rural Banks, Lead bank, Scale of finance - Higher financial institutions: RBI, NABARD, AFC, ADB, World Bank and Deposit Insurance and Credit Guarantee Corporation of India - Microfinance and Its role in poverty alleviation - Self-Help Groups - Non-Governmental Organizations - Subsidized farm credit, Differential Interest Rate (DIR), Kisan Credit Card (KCC) Scheme - Relief Measures and Loan Waiver Scheme and Know Your Customer (KYC)

UNIT IV **9 Hours**

CO-OPERATION

Co-operation: Philosophy and Principles - History of Indian Co-operative credit movement: Pre and Post-Independence periods and Co-operation in different plan periods - Co-operative credit institutions: Two tier and three tier structure, Functions: provision of short term and long term credit, Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit - Successful co-operative credit systems in Gujarat, Maharashtra, Punjab, etc. - Special Co-operatives: LAMPS and FSS: Objectives, role and functions - National Cooperative Development Corporation (NCDC) and National Federation of State Cooperative Banks Ltd. (NAFSCOB): Objectives and functions

UNIT V **9 Hours**

BANKING AND INSURANCE

Meaning, Importance and Types - Central bank: RBI - functions - Credit control - Objectives and Methods: CRR, SLR and Repo rate - Credit rationing - Dear money and cheap money - Financial Inclusion and Exclusion: credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap - Non- Banking Financial Institutions (NBFI) - Assessment of crop losses, Determination of compensation - Crop Insurance Schemes - Livestock Insurance Schemes - Agricultural Insurance Company of India Ltd (AIC)

FOR FURTHER READING

Role of technology in finance and banking sector in India

Total: 45 Hours

Reference(s)

1. Subba Reddy, S. and P. Raghu Ram. 2011. Agricultural Finance and Management. Oxford & IBH. New Delhi.
2. Muniraj, R. 1987. Farm Finance for Development. Oxford & IBH. New Delhi.

3. Lee, W.F., M.D. Boehlje, A.G. Nelson and W.G. Murray. 1998. Agricultural Finance.Kalyani Publishers. New Delhi
4. Patnaik, V.E. and A.K. Roy. 1988. Cooperation and Cooperative Management. Kalyani Publishers, Ludhiana.

21AG040 TECHNOLOGY OF SEED PROCESSING 3 0 0 3

Course Objectives

- To acquire the knowledge on the various seed production and processing technologies
- To impart knowledge on seed testing and the methods
- To impart knowledge about seed certification, legislation and industries in India

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Organize various technologies available in seed production
2. Implement the seed processing techniques and identify various seed processing equipment
3. Select the different methods and procedure to test the seeds
4. Use the knowledge on certification and legislation in seed industries
5. Assess the growth of seed industry and their role in India

ArticulationMatrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	1	2	1						1		
2	2	3	2	1	2	1						1		
3	2	1	2	1	1	3						1		
4	2	2	3	1	2	1						1		
5	2	2	2	2	2	1	1					1		

UNIT I **9 Hours**

SEED PRODUCTION TECHNOLOGY

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 **10 Hours**

SEED PROCESSING TECHNOLOGY

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

UNIT III **9 Hours**

SEED TESTING

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 **9 Hours**

SEED CERTIFICATION AND LEGISLATION

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 **8 Hours**

SEED INDUSTRY IN INDIA AND THEIR ROLE IN AGRICULTURAL DEVELOPMENT

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

FOR FURTHER READING

Ozone treatment of seeds

Total: 45 Hours

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

21AG041 MUSHROOM CULTIVATION AND VERMICOMPOSTING 3 0 0 3

Course Objectives

- To provide hands on training for preparing the mother culture (Spawn production).
- To study the various methods of mushroom cultivation.
- To provide the training for using appropriate technology, utilization of resources and suitable market strategy for mushroom production

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Execute the important of mushroom and how it can convert waste material into human food.
2. Organise the different methods of mushroom spawn production within a relatively small space
3. Assess various types cultivation practices of mushroom under different agro climatic zones of Tamil Nadu and India
4. Find the post harvest methods and value addition of mushroom for extend the shelf life
5. Assess the marketing linkages with centre to increase employment opportunities and generating income

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1					1		2		1			
2									3		1			
3		1	1			1		1	2		3			
4		2							1	1				
5		2							1	1	1			

UNIT I **9 Hours**

INTRODUCTION OF MUSHROOM

History of mushroom - Scope and Importance - Life cycle of mushroom - Area, Production, Productivity of mushroom in World, India and Tamil Nadu, Types of mushroom - Oyster mushroom - Paddy straw mushroom - Button mushroom - Milky mushroom - Shiitake mushroom - Other mushrooms - Different parts of a typical mushroom & variations in mushroom morphology.

UNIT II **9 Hours**

MOTHER SPAWN PRODUCTION

Mushroom growing technologies - Facilities required for spawn preparation, Preparation of spawn substrate, preparation of pure culture, media used in raising pure culture, culture maintenance, storage of spawn. - Growing conditions for mushrooms - Composting technology, mushroom bed preparation. Spawning, spawn running, harvesting. Cultivation of oyster and paddy straw mushroom.

UNIT III **9 Hours**

PEST MANGEMENT AND POST HARVEST METHODS

Problems in cultivation - diseases, pests and nematodes, weed moulds and their management strategies. Post-harvest technology and value addition of mushroom

UNIT IV **9 Hours**

PEST MANGEMENT AND POST HARVEST METHODS

Pest and diseases of mushroom - Harvesting, storing and using mushrooms - post-harvest technology and value addition of mushroom

UNIT V **9 Hours**

VERMICOMPOST COLLECTION AND PRODUCTION TECHNIQUES

Waste material: Classification, segregation & processing; Bed preparation – earthworm collection and applications; Inspection of beds and watering – separation, air drying, sieving & storing

FOR FURTHER READINGS

Government policies and programmes for promotion of mushroom

Total: 45 Hours

Reference(s)

1. Mushroom Cultivation (Paperback, N. Revathy, A. Vijayasamundeeswari, V.M. Indumathi, V. Gomathi), Shanlax Publications, ISBN: 9789390082735, Edition: 1, 2020
2. V.N. Pathak, N. Yadav and M. Gaur. 2010. Mushroom production and processing technology. Published by Agrobios, Jodhpur
3. B.C. Suman and V.P.Sharma.2007. Mushroom cultivation in india. Daya Publishing House, New Delhi.179p
4. R.D. Rai and T. Arumuganathan (2008). Post-Harvest Technology of Mushrooms, Technical Bulletin 2008, NRCM, ICAR, Chambaghat, Solan1731213, (H.P.)
5. Anand B. Masthihole and L. Nalina (2016) Organic Farming. Agrimoon.Com

21AG044 PRINCIPLES OF ORGANIC FARMING 3 0 0 3

Course Objectives

- To Understand the Concept of Organic Farming.
- To Understand the Scope and Importance of Organic Farming.
- To Ensure Safe and Healthy Food production.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Assess the holistic concept organic farming as a system
2. Find the cultural production practices typically employed in organic farming
3. Organize the challenges and trends in the production, processing, and marketing of organic farm products
4. Determine the large body of literature relating to organic agriculture
5. Organize and develop an organic production system

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1	1		1	2		2	3		1		
2				1			2		3	2		1		
3	1			1	3	2			3			2		
4				1	2	1		2		3		1		
5				1	2				2	3		2		

UNIT I **9 Hours**

FUNDAMENTALS OF ORGANIC FARMING

Introduction to organic farming: Definition, concepts, principles and objectives, characteristics - relevance to modern agriculture. Converting soil into organic. Basic concepts of cropping pattern, cropping system and farming system. Integrated Farming System

UNIT II **10 Hours**

ORGANIC FARMING INITIATIVES & COMPOSTING METHOD

Initiatives taken by the central and state governments, NGO's and other organizations for promotion of organic agriculture in India. Organic nutrient sources and their fortification – organic manures- methods of composting, Green manures- bio fertilisers – types, methods of application – benefits and limitations.

UNIT III **10 Hours**

ORGANIC ECOSYSTEM AND NUTRIENT MANAGEMENT

Nutrient use in organic farming-scope and limitations, Nutrient management in organic farming, Organic ecosystem and their concepts, Choice of crops and varieties in organic farming – crop rotations – need and benefits – multiple cropping.

UNIT IV **10 Hours**

ORGANIC CROP AND PEST MANAGEMENT

Fundamentals of insect, disease and weed management under organic mode of production-cultural-biological methods-non chemical pest & disease management. Botanicals- pyrethrum, neem seed kernel extract, neem seed powder, soluble neem formulations, neem oil. Operational structure of NPOP – other agencies for organic production.

UNIT V **6 Hours**

ORGANIC CERTIFICATION

Inspection – certification - labelling and accreditation procedures for organic products. Processing, - economic consideration and viability. Marketing and export potential of organic products – national economy

FOR FURTHER READING

Case studies of Indigenous Technical knowledge e (ITK) for nutrient, insect, pest, disease and weed management**.** Visit to organic farms to study the various components and their utilization

Total: 45 Hours

Reference(s)

1. Balasubramanian, R., Balakishnan, K and Siva Subramanian, K. 2013. Principles and practices of organic farming. Satish Serial Publishing House. 453p
2. Tarafdar, J.C., Tripathi, K.P and Mahesh Kumar, 2009. Organic agriculture. Scientific Publishers, India. 369p.
3. Tiwari, V.N., Gupta, D.K., Maloo, S.R and Somani, L.L. 2010. Natural, organic, biological, ecological and biodynamic farming. Agrotech Publishing Academy, Udaipur. 420p.
4. Mukund Joshi and Prabhakarasetty, T.K. 2006. Sustainability through organic farming. Kalyani publishers, New Delhi. 349p

21AG045 WATER HARVESTING TECHNIQUES 3 0 0 3

Course Objectives

To enhance the awareness about water resources management and conservation

To acquire knowledge about water harvesting techniques and their implementation

To practice the design aspects of sustainable rainwater harvesting solutions for communities

Programme Outcomes (POs)

a: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

f: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

n: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Understand the basic concepts of global water availability, conservation and challenges

2. Understand the principles of water harvesting and types of rainwater harvesting systems

3. Apply the concepts of water harvesting techniques for selection based on source, storage and use

4. Analyze the characteristics of flood water and groundwater for their optimal harvesting

5. Analyze the design aspects of various surface and subsurface water harvesting systems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2				2	3							1
2	2	2	3			1								2
3		1	3			1	1							1
4	2	1	3			1	1							1
5	1	1	3			2	2							1

UNIT I **9 Hours**

WATER RESOURCES AND CHALLENGES

Global water distribution – primary and secondary sources of water – technical social and cultural aspects. Global challenges in water and climate – water scarcity – water pollution – Indian scenario. Watershed – water resources management – public participation – integrated approach. Water governance – water sharing plans – policy, schemes and concerns.

UNIT II **9 Hours**

WATER HARVESTING CONCEPTS

Principles of water harvesting – collection at micro and macro levels, flow control, storage and uses. Rainwater harvesting systems – traditional and contemporary – groundwater recharge. Water resources inventory – site analysis – database collection – water allocation principles based on demand and supply. Traditional water harvesting systems – practices in India – references in old texts – reasons for their deterioration – way forward.

UNIT III **9 Hours**

WATER HARVESTING TECHNIQUES

Water harvesting principles for rural and urban – classification based on source, storage and use. Short-term and micro-level harvesting techniques for runoff – terracing and bunding – rock and ground catchments. Long-term and macro-level harvesting techniques for runoff – farm ponds – percolation ponds and nala bunds. Design considerations – site selection – selection of system and components – cost estimation – optimization for sustainable operation.

UNIT IV **9 Hours**

FLOOD WATER AND GROUNDWATER HARVESTING

Floods – causes of urban floods and droughts – characteristics of water spread – impacts. Flood water harvesting – permeable rock dams – water spreading bunds – flood control reservoir. Groundwater harvesting – aquifer characteristics – subsurface techniques – infiltration wells – recharge wells – groundwater dams – managed aquifer recharge. Watershed-based approach – project planning at micro and macro levels – community participation – rain centers

UNIT V **9 Hours**

DESIGN ASPECTS OF WATER HARVESTING SYSTEMS

Estimation of water availability – selection of runoff coefficients – computation of rainwater runoff volume – hydrograph analysis. Design of drainage system – types – design criteria – filter design – causes of failures. Design of storage structures – storage capacity – selection of component – methods of construction. Trenching and Diversion Structures – types – site selection – design criteria – most economic section – design consideration of ditch system.

FOR FURTHER READING

Global history of RWH – water sharing policy – water quality management – construction materials and processes – project on designing a RWH system for a residential complex, factory, college, any other institution – field visit

Total: 45 Hours

Reference(s)

1. Theib YO, Dieter P, Ahmed YH, Rainwater Harvesting for Agriculture in the Dry Areas, CRC Press, Taylor and Francis Group, London, 2012.
2. Lancaster, Brad. Rainwater Harvesting for Drylands and Beyond, Volume 1, 3 rd edition, Rain source Press. 2019.
3. Das M, Open Channel Flow, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
4. Michael AM, Ojha TP, Principles of Agricultural Engineering, Volume II, 4th Edition, Jain Brothers, New Delhi, 2003.
5. Suresh R, Soil and Water Conservation Engineering, Standard Publisher Distributors, New Delhi, 2014.

ONE CREDIT
18AG0XA OPERATION AND MAINTAINANACE OF MICRO IRRIGATION SYSTEM **1 0 0 1**

Course Objectives

- To understand the components of micro irrigation
- To assess the location of malfunctioning in micro irrigation
- To rectify the issues to ensure proper functioning of the system

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Will be familiarized with different components of micro irrigation system
2. Can easily identify the problem and rectify it

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1											
2	2		1											

UNIT I **3 Hours**

INTRODUCTION TO MICRO IRRIGATION SYSTEM

Drip Irrigation - Types and Advantages - Components-Sprinkler Irrigation System - Components - Automation in Micro Irrigation System - Components in Automation - Relay and Switches for Automation.

UNIT II **4 Hours**

MAINTENANCE OF DRIP IRRIGATION SYSTEM

Daily Maintenance - Fortnightly Maintenance - Monthly Maintenance - Half Yearly Maintenance - General Maintenance Tips -Precautions for Inline System

UNIT III **4 Hours**

CHEMICAL TREATMENTS IN DRIP IRRIGATION SYSTEM

Acid Treatment- Types of Acids-Procedure for Acid Treatment -Troubleshooting - Chlorine Treatment - Sources of Chlorine -Procedure for Chlorine Treatment - Safety Precautions during Chlorine Treatment.

UNIT IV **4 Hours**

TROUBLE SHOOTING AND REMEDIES

Leakages in Submain, Inline, Lateral Joints- Non Uniformity in Drippers - Drop in Pressure - Opening and Closure of Solenoid Valves - Connectivity in Electrical Communication for Automation.

Total: 15 Hours

18AG0XD CUSTOM HIRING CENTRE 1 0 0 1

Course Objectives

- To understand the importance of farm mechanization and labour shortage in agricultural operation.
- To learn the operationalization and establishment of CHCs
- To study the cost of operation of the farm implements and equipments.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Possess the knowledge on the importance of CHCs in the field of agricultural engineering
2. Know the cost of operation per unit area.
3. Explain why custom hiring centre is important for farm mechanization.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2										1	
2		3	2										1	
3				1		1		1					1	

UNIT I **4 Hours**

INTRODUCTION

Introduction to farm mechanization- establishment of CHC- operationalization- machinery selection- area wise-crop wise- storage of implements.

UNIT II **4 Hours**

COST OF OPERATION

Methods of cost of operation-cost fixing-hour basis-area basis- depreciation methods- straight line, declining balance, sum of- the- years- digit- fixed cost- variable cost- breakeven point

UNIT III **3 Hours**

TILLAGE AND SOWING EQUIPMENTS

Tillage-primary tillage-sub-soiler, chisel, MB plough, disc plough-secondary tillage-rotavator, cultivator, disc harrow- laser leveler- sowing equipments- broadcaster- sedd drill, seed sum fertilizer drill- planter-paddy transplanter- vegetable transplanter-nursery raising methods- cost of operation calculation.

UNIT IV **4 Hours**

INTERCULTURAL IMPLEMENTS

Weeder-wet land , dry land -cono weeder, power weeder- sprayer-manual, power -duster- manual,power-fertilizer applicator-manure spreader- cost of operation calculation

UNIT V **4 Hours**

HARVESTING MACHINERY

Harvester- paddy, sugarcane, ground nut- digger- potato, carrot, onion- thresher- maize, paddy- cost of operation calculation.

Total: 15 Hours

18AG0XE AGRO PROCESSING CENTRE 1 0 0 1

Course Objectives

- Understand different components of a Agro-Processing Centre and the various process involved in it.
- Understand the processing of various food products and value addition
- Apply knowledge of Agro-Processing Centre (APC) for entrepreneurship.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Understand different components of a Agro-Processing Centre and the various process involved in it
2. Understand the processing of various food products and value addition
3. Apply knowledge of Agro-Processing Centre (APC) for entrepreneurship.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2											1	
2		2			1								1	
3		2											1	

UNIT I **4 Hours**

ESTABLISHMENT OF AGRO PROCESSING CENTRE

Introduction- Agro processing centre - factors involved in Agro-Processing Centre - Survey- design - plant layout - Crop wise production -Population of villages- Machines identified for agro-processing centre- Location of the site of Agro Processing Centre- Existing farm level processing facilities in village - Processing facilities available in village- Details of equipments/machines in Agro Processing Centre- Economic analysis of Agro Processing Centre

UNIT II **6 Hours**

PROCESSING AND VALUE-ADDITION TECHNOLOGY FOR CEREALS, PULSES AND OILSEEDS

Introduction - cereals- rice - processing - equipments- by products and importance- value addition processed products- fermented products- extruded products- instant mixes- preparation of supplementary food mix- wheat, oats , barley pulses and oil seeds - processing - equipments- by products and importance- value addition.

UNIT III **5 Hours**

PROCESSING AND VALUE-ADDITION TECHNOLOGY FOR RATOON CROPS, FRUITS AND VEGETABLES

Introduction- ratoon crops- sugarcane, forage crops - fruits- amla, mango,papaya, guava, pianapple, tamarind and other fruits- processing - equipments- by products and importance- value addition- vegetables- onion, tomato, green leafy, roots, tubers and other vegetables- processing - equipments- by products and importance- value addition

UNIT IV **5 Hours**

PROCESSING AND VALUE-ADDITION TECHNOLOGY FOR SPICES, PLANTATION CROPS AND MEDICINAL PLANTS

Introduction- spices- Turmeric, chilly, ginger, pepper, cardamom and other spices - processing - equipments- value addition- plantation crop- coconut, tea, coffee, nuts and cocoa- processing - equipments- - by products and importance- value addition- medicinal plants- amla, bael and stevia- processing - equipments-- by products and importance- value addition

Total: 20 Hours

Reference(s)

1. Mangaraj Shukadev, Agro Processing and Value Addition for Entrepreneurship DevelopmentSatish, Serial Publishing House, 2014
2. Bakker-Arkema, CIGR Handbook of Agricultural Engineering, Volume IV Agro-Processing Engineering , Published by the American Society of Agricultural Engineers, USA.

18AG0XF LANDSCAPE DESIGNING AND ARCHITECTURE

1 0 0 1

Course Objectives

- To provide broad overview on various landscaping software
- To create perspective visualization on landscaping concepts
- To impart hands on training and skill in developing garden designs through software

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Understand broad overview on various landscaping software
2. Understand perspective visualization on landscaping concepts
3. Apply knowledge of landscaping designs through software

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2		2	2											
3	1	2												

UNIT I **4 Hours**

INTRODUCTION

Introduction to landscape horticulture - Overview of software for Computer Aided Design and Drafting (CADD) related landscape graphic oriented software (Real time landscape, 3D Max, Archi-CAD, etc.) Graphic communication

UNIT II **4 Hours**

PERSPECTIVE

Perspective sketching Plan drawing section object portions view points Elevation - Design forum Master planning residential and corporate landscape designs Landscape projects Architecture projects

UNIT III **4 Hours**

AUTOCAD

AUTOCAD plants and Design Coordinate system- Drawing tools- Modifying tools- Drawing properties- Dimensioning - Layer, Block, Group and attribute setting - Autocad design centre - Shortcut keys

UNIT IV **4 Hours**

PHOTOSHOP

Photoshop and Sketch up Basic drawing concepts of photoshop and its applications in CAD landscape designs Google sketch up to three-dimensional rendering 2 D drawing to presentation drawing Free sketch up download

Total: 16 Hours

Reference(s)

1. Christine Wein - Ping Yu. 1987. Computer aided design: Application to conceptual thinking in landscape architecture
2. http://www.cadforum.cz

18AG0XG MILLET PROCESSING AND COOKIES

Course Objective

- Learn the concept and the components involved millet processing.
- Impart knowledge of application of cookies.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Understand different components of a millet processing and the various processes involved in it.
2. Understand the processing of various millet based food products and value addition
3. Apply knowledge of millet processing and cookies for entrepreneurship.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												2
2	1	2												2
3	1	2												2

Unit 1

MILLETS CHEMISTRY AND NUTRITION **3 Hours**

Types of millets- Chemical components of millets- Nutritional quality of major and minor millets – Basics of millet production and processing

Unit 2

MAJOR MILLETS PROCESSING **5 Hours**

Processing of sorghum- Processing of Pearl millet- Processing of Finger millet – Products from major millets

Unit 3

MINOR MILLETS PROCESSING **5 Hours**

Processing of Barnyard Millet, Kodo Millet, Little Millet, Proso Millet, Foxtail Millet – Minor millet products and their production techniques

Unit 4
MILLET COOKIES **4 Hours**

Basics of cookie production technology –Millet cookie Recipes – Packaging and storage of cookies

Unit 5
COMMERCIALIZATION OF MILLET PRODUCT **3 Hours**

Start-up and small scale millet product industry-Government policies and Procedures- Basic requirements – Funding agencies- Procedure for financial support applications

Total: 20 Hours

Reference(s)

1. Reddy, P. R., & Arya, S. S. (2018). *Processing of millets: Methods, techniques, and applications*. Springer. https://doi.org/10.1007/978-3-319-91752-6
2. Shanmugam, K., & Ramesh, N. J. (2020). *Millet processing and products*. CRC Press. https://doi.org/10.1201/9780367133999
3. Parameswaran, S., & Venkatesh, M. G. (2021). *Innovations in millet processing and cookie development*. Elsevier. https://doi.org/10.1016/B978-0-12-823555-2

18AG0XH COCONUT PROCESSING AND VALUE ADDITION 1 0 0 1

Course Objective

- Learn the concept and the components involved millet processing.
- Impart knowledge of application of cookies.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Assess the importance of post-harvest processing in coconut processing.
2. Understand the processing of various coconut products and value addition
3. Apply knowledge of coconut processing for entrepreneurship.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												1
2		2												1
3	1	2												2

UNIT I **8 Hours**

INTRODUCTION

Coconut- production and importance - post harvest processing of coconut - harvesting and stages of harvest - drying, cleaning and grading-Coconut products-Copra- Coconut oil extraction process - Traditional method of oil extraction - Mechanical extraction of coconut oil from the fresh coconut meat - Coconut cake.

UNIT II **9 Hours**

VALUE ADDED PRODUCTS FROM COCONUT

Coconut honey-Coco sauce-Coconut lemonade-Nata-de-coco -Coconut kernel or white meat-Desiccated coconut-Coconut Chips-Coconut Crisps-Roasted young coconut-Dehydrated sweet coconut-Coconut milk-Sweetened condensed coconut milk-Coconut milk powder-Coconut flour-Tender coconut water concentrate-Coconut jiggery-Coconut vinegar-Neera.

Total: 17 Hours

Reference(s)

1. http://agritech.tnau.ac.in/horticulture/horti_tv_coconut_nutri_mgmt.html
2. http://www.coconutboard.nic.in/CoconutProducts.aspx

18AG0XI MACHINERY SYSTEM FOR PRECISION AGRICULTURE 1 0 0 1

Course objectives

- To understand the concept of Precision Agriculture in farm mechanization and learn the different electronic components, sensors, microcontrollers and actuators for agricultural operations
-

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course outcomes (COs)

1. Understand the importance of Precision Agriculture in the field of agricultural engineering.
2. Apply sensors, microcontroller and actuator for agricultural operations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	2	2										
2		2	2	2										

UNIT I **4 Hours**

PRECISION AGRICULTURE (PA)

Role of electronics in Agricultural Engineering. Concept of precision agriculture, tools for implementation of precision agriculture. Introduction of GIS/GPS positioning system for precision farming.

UNIT II

PRECISION AGRICULTURE EQUIPMENTS AND MACHINERY **4 Hours**

Functional design, specifications, requirements and working of farm machineries needed for precision sowing and planting, laser guided leveller, power sprayer, straw chopper cum spreader, straw baler, combine harvester etc.

UNIT III

SENSORS AND ACTUATOR FOR PA **4 Hours**

Types of sensor - principle and concept of different sensor like ultrasonic, PIR, IR, radar, pressure, gas, temperature, moisture, strain /weight, colour sensor etc used in agriculture. Types of actuator- DC Motor, DC Pump, linear Actuator, linear solenoid, colour sensor etc.

UNIT IV

MICROCONTROLLER AND PROGRAMMING FOR PA **4 Hours**

Microcontroller - Programming in micro-controller for different agriculture operation. Experiment using ultrasound and IR sensor for detection based system for plant protection

operation. Experiment using temperature and moisture sensor for irrigation management

Total: 16 Hours

References

1. Brase, T.A. 2006. Precision Agriculture. Thomson Delmar Learning, New York.
2. Hermann, J.H. 2013. Precision in Crop Farming, Site Specific Concepts and Sensing Methods: Applications and Results. Springer, Netherlands.
3. Krishna, K. R. 2016. Push Button Agriculture Robotics, Drones, Satellite-Guided Soil and Crop Management. Apple Academic Press
3. Srivastava, A K., Carroll E.G., Roger P. R. and Dennis R.B. 2006. Engineering Principles of Agricultural Machines. ASABE, USA.
5. Zhang, Q. 2015. Precision Agriculture Technology for Crop Farming. CRC Press, New York.

18AG0XJ HYDROPONICS 1 0 0 1

Course Objectives

- To understand the concepts of hydroponics farming system and study about inputs, and control systems for automation in hydroponics

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Develop a hydroponics system for indoor farming .
2. Programme automatic control systems for maintaining optimal growth of plants in hydroponic farming.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	2	2	2									
2		2	2	2	2									

UNIT I **8 Hours**

INTRODUCTION TO HYDROPONICS

Introduction – Soil less culture – Methodology – Plant life cycle – Different stages in seed to harvest – An overview of different hydroponic systems. Growing media – Types of soil less media – Understanding organic farming – Organic vs Hydroponics – Key measurements for hydroponics production success. Plant nutrition – Elements needed by plants – chemical ions / diffusion. Hydroponic Nutrients – Mechanism / reactions in root zone. Nutrient deficiencies – Identifications and treatment for deficiencies. Deep Water Culture technology – system design and engineering aspects – Growing plants in DWC – Technology – plant physiology interaction – construction of Dutch bucket setup.

UNIT II **8 Hours**

CONTROLLED ENVIRONMENTAL FARMING AND AUTOMATION

Controlled environmental agriculture – An introduction to need of Greenhouse – Greenhouse types - Suitable types for different climatic zones - Greenhouse automation – Technological automation of climate control in a greenhouse. Parameters of control for plants - Parameters of control for root - Analysis of

Farm Automation Systems - Analysis of real time automation data. Basic introduction to Indoor farming – Need of light for plant growth. Difference between Indoor and Greenhouse farming. Hydroponics Business Opportunities - Market landscape and opportunity - Pitfalls to avoid - Case studies

Total: 16 Hours

Reference(s)

1. Sharma, N., Acharya, S., Kumar, K., Singh, N., & Chaurasia, O. P. (2018). Hydroponics as an advanced technique for vegetable production: An overview. Journal of Soil and Water Conservation, 17(4), 364- 371.
2. Shrestha, A., & Dunn, B. (2010). Hydroponics. Oklahoma Cooperative Extension Service.
3. https://ccari.icar.gov.in/Hydroponics.pdf
4. https://rkvy.nic.in/Uploads/SucessStory/TAMILNADU/2016/2016023524Hydrophonic_Final.pdf

18AG0XK **AUTOMATION AND TROUBLESHOOTING OF MICRO IRRIGATION SYSTEM** **1 0 0 1**

Course Objectives

- To understand the working and components of automation of micro irrigation
- To find the location of malfunctioning in micro irrigation
- To rectify the issues to ensure proper functioning of the system

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel

Course Outcomes (COs)

1. Familiarize with different components in automated micro irrigation system
2. Identify practical problems in the field and to provide solutions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	2		2								2	
2			2	2	2								2	

5 Hours

AUTOMATION

Drip and Sprinkler Irrigation System automation - Automation components - Opening and closing of Solenoid valves - Connectivity in Electrical Communication for Automated irrigation.

10 Hours

MAINTENANCE AND TROUBLESHOOTING ACTIVITIES

Daily Maintenance - Monthly Maintenance - Half Yearly Maintenance - General Maintenance Tips - Precautions for Inline and online system - Foggers and misters - Working - Implementation in greenhouse - Troubleshooting and remedies - Automation for multi and intercropping system.

Total: 15 Hours

Reference(s)

1. V.Ravikumar and M.V.Ranghaswami, Micro irrigation and irrigation pumps. Kalyani Publishers, Ludhiana. 2011
2. A.M.Michael, Irrigation theory and practice, Vikas publishers, New Delhi, 2010

18AG0XL ALGAE FOR HEALTH AND WEALTH 1 0 0 1

Course Objectives

- Students will acquire a deep knowledge on Biotechnological aspects and benefits of Spirulina farming
- Students will learn about advance methods of Spirulina cultivation, value addition and scale up strategies
- Students will develop a skill on the branding, export and marketing aspects of Spirulina

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

n. To improvise better ways to minimize the crop loss from field damage during post harvest management and energy utilization, sorting, processing and packaging

Course Outcomes (COs)

1. Apply knowledge for the establishment of Spirulina plant for commercial production
2. Analyze cost effective strategies for the production of value added Spirulina as nutritional supplements

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	2				2							2
2			2			2								2

5 Hours

INTRODUCTION

History of Spirulina, Scope-state, national and International levels, Biotechnological aspects and benefits of Spirulina farming-health benefits-nutritional supplements, obesity control, immunity development, cholesterol control, boosting metabolism, mental health improvement.

10 Hours

ADVANCED CULTIVATION METHODS

Advanced Cultivation methods-from seed to harvest-growth conditions, commercial and mass cultivation, harvesting, costing and Project estimation, challenges, value addition - Spirulina plant setup, marketing aspects, branding, export and market potential, role of financial Institutions and subsidies.

Total: 15 Hours

Reference(s)

1. Microbes as Geologic Agents: Their Role in Mineral Formation -Henry L. Ehrlich, Geomicrobiology Journal -Volume 16, 1999 - Issue 2
2. Spirulina Platensis Arthrospira: Physiology, Cell-Biology And Biotechnology, Avigad Vonshak CRC Press, 21-May-1997

18AG0XM	PROGRAMMING FOR AGRICULTURAL AUTOMATION	1 0 0 1

Course Objectives

- To impart the knowledge on Embedded C Programming.
- To provide comprehensive background knowledge of OOPS concepts in embedded C.
- To impart embedded applications using high level programming.

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel

Course Outcomes (COs)

1. Apply Programming language by creating a class using inheritance.
2. Abstract the architectural support for high level languages.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	2		3								2	
2			2		3								2	

5 Hours

PROGRAMMING LANGUAGES

C and Assembly- Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements -Programming Process - More Control Statements.

10 Hours

ADVANCED TOPICS

Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization - In-line Assembly - Data types, Expression and control statements Iteration- Functions- Creating classes and Abstraction - Linear data structures - Implementation of stacks and Queues, Linked List - Implementation of linked list, Sorting, Searching, Insertion and Deletion, Nonlinear structures.

Total: 15 Hours

Reference(s)

1. Mark Siegesmund. Embedded C Programming, Techniques and Applications of C and PIC MCUS. Elsevier Publishers (2014)
2. Barr, Michael, and Anthony Massa. Programming embedded systems: with C and GNU development tools. O'Reilly Media, Inc. (2006).

18AG0XN HVAC - HOURS ANALYSIS 1 0 0 1

Course Objectives

- To impart fundamental knowledge in Heating, ventilating and Air-conditioning.
- To understand the concepts of energy audit in Heating, ventilating and Air-conditioning.
- To understand the duct design for Heating, ventilating and Air-conditioning.

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel

Course Outcomes (COs)

1. To understand the concepts of HVAC, duct design and energy analysis.
2. To evaluate the performance of air conditioning using standard tests.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	2		3								2	
2			2		3								2	

8 Hours

INTRODUCTION TO HVAC

Scope of designing-Basics and importance of HVAC-Future advancements in HVAC-Standards and codes used in HVAC-Modes of heat transfer in a building-Basic components of air conditioning-Types of refrigeration cycle-vapor absorption refrigeration system-vapor compression refrigeration system-study on psychrometric charts (manual and software)-Study on refrigerants-Types of refrigerants-Evaporating & condensing properties of refrigerants.

7 Hours

TYPES OF AIR CONDITIONING SYSTEMS

Window air conditioning systems-Split air conditioning systems-Ductable split AC-Package air conditioning systems-Categories of air conditioning-Air cooled system of air conditioning-Chilled water system of air conditioning–Air water system of air conditioning-Direct refrigerant system of air conditioning-Energy-conservation measures-District-Cooling, geothermal, under-floor-cooling-Energy recovery wheel-Various refrigerant volume.

Total: 15 Hours

Reference(s)

1. Ross Montgomerry & Robert Mcdowell, Fundamentals of HVAC control system. https://jntukucen.ac.in/ebook_files/106.pdf
2. https://www.hvactechgroup.com/files/HVAC4th.pdf

18AG0XO **TESTING AND EVALUATION OF FARM MACHINERY** **1 0 0 1**

Course Objectives

- To introduce the different standards of testing and evaluation procedure of farm machinery
- To provide hands-on-training on testing of land preparation and inter-cultural machinery

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m. Model, design and analyze agricultural machineries and implements to increase productivity, improve land use and conserve resource like seed, water, fertilizer, pesticide and fuel

Course Outcomes (COs)

1. Understand the importance of testing of farm machinery/equipment.
2. Evaluate the performance of agricultural tractor using standard tests.
3. Evaluate the performance of tillage and sowing equipment using standard tests.
4. Evaluate the performance of intercultural and plant protection using standard tests.
5. Evaluate the performance of harvester and combine harvester using standard tests.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	2		3								2	
2			2		3								2	
3		2	2		3								2	
4		2	2		3								2	
5			2		3									

3 Hours

TESTING STANDARDS

Testing and evaluation system in India - standardization efforts - type of testing systems – General regulations - terminology- basic measurements and instruments.

3 Hours

TESTING AND EVALUATION OF AGRICULTURAL TRACTOR

Test codes -Speed, fuel consumption, smoke density and power measurement - test items, specifications checking - PTO performance test- Engine test, drawbar performance test - field test-testing procedure.

3 Hours

TESTING AND EVALUATION OF TILLAGE AND SOWING EQUIPMENT

Test codes -Testing and evaluation of Tillage sowing machinery - Laboratory test (hardness testing, chemical analysis, calibration) - field test (rate of work, quality of work, draft measurement, fuel consumption) - - field checking and field test.

4 Hours

TESTING AND EVALUATION OF INTERCULTURAL AND PLANT PROTECTION EQUIPMENT

Test codes -Testing and evaluation of weeders and sprayers- - terminology - procedure for laboratory testing - material for field test - observations during field test - sample analysis- data analysis - summary of performance parameters - analysis of field test.

3 Hours

TESTING AND EVALUATION OF HARVESTER AND COMBINE HARVESTER

Test codes -Testing and evaluation of harvesters and combine harvesters – terminology- procedure for laboratory testing - material for field test - observations during field test - sample analysis- data analysis - summary of performance parameters - analysis of field test.

Total: 16 Hours

Reference(s)

1. Metha M.L., SR.Verma, K Mishra and V.K. Sharma. 1995. Testing and Evaluation of Agricultural Machinery, National Agricultural Technology Information Centre, Ludhiana.
2. Anonymous, 1983. RNAM test code & Procedures for Farm Machinery. Technical series 12.
3. Nebraska Tractor Test code for Testing Tractor, Nebraska, USA

Text Books:

1. Metha M.L., SR.Verma, K Mishra and V.K. Sharma. 1995. Testing and Evaluation of Agricultural Machinery, National Agricultural Technology Information Centre, Ludhiana
2. Indian standard test codes related to tractors, power tillers and agricultural implements