HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution, Affiliated to Anna University, Chennai
Approved by AICTE, New Delhi & Accredited by NAAC with 'A' Grade)
Coimbatore – 641 032

B.E. AGRICULTURE ENGINEERING

HINDUSTHAN
EDUCATIONAL AND CHARITABLE TRUST

HICET

Curriculum & Syllabus

2020-2021

CHOICE BASED CREDIT SYSTEM

VISION AND MISSION OF THE INSTITUTION

VISION

To become a premier institution by producing professionals with strong technical knowledge, innovative research skills and high ethical values.

MISSION

1M1: To provide academic excellence in technical education through novel teaching methods.

1M2: To empower students with creative skills and leadership qualities.

1M3: To produce dedicated professionals with social responsibility.

VISION AND MISSION OF THE DEPARTMENT

VISION

To become a department of excellence in agricultural engineering by producing socially conscious professionals with good technical knowledge and innovative skill sets.

MISSION

MI: To impart strong technical knowledge in agricultural engineering through conducive learning environment.

M2: To empower students with innovative skill sets to address agricultural issues.

M3: To produce socially responsible agricultural professionals and provide sustainable solutions

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AGRI - HiCET

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HiCET

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO 1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engmeenng problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineenng SCIences.

PO 3. **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.

PO 4. **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.

PO 5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modem engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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PO 6. 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 engmeenng practice.

PO 7. 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.
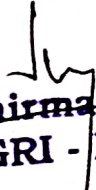
PO 8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

POIO. 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.

PO 1 1 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.

POI2. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long leamin in the broadest context of tech

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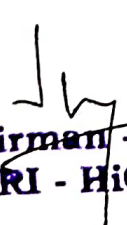
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PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1. Ability to understand agricultural scenario in World and India and superimpose agricultural engineering technologies for uplifting the agriculture.

PSO 2. Ability to solve various issues in agriculture by infusing farm mechanization, conservation strategies for soil, water and renewable energy, advanced irrigation techniques and post harvest technology.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1. Graduates shall exhibit their sound theoretical, practical skills and knowledge for being a successful professional.

PEO 2. Graduates shall be creative with leadership qualities and lifelong learning skills.

PEO 3. Graduates shall hold high ethical values and be able to devise sustainable solutions to address agricultural issue.

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CURRICULUM

Hindusthan College of Engineering and Technology

(An Autonomous Institution, Affiliated to Anna University, Chennai
Approved by AICTE, New Delhi &Accredited by NAAC with 'A'Grade)
Valley Campus, Pollachi Highway, Coimbatore, Tamil Nadu.

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. AGRICULTURE ENGINEERING

REGULATION-2016 & 2019

REGULATION-2019

For the students admitted during the academic year 2020-2021 and onwards

SEMESTER I

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
		THEORY								
1	19HE1101	Technical English	HS	3	0	0	3	25	75	100
2	19MA1102	Calculus and Linear Algebra	BS	3	1	0	4	25	75	100
3	19ME1101	Basics of Civil and Mechanical Engineering	ES	3	0	0	3	25	75	100
		THEORY WITH LAB COMPONENT								
4	19PH1151	Applied Physics	BS	2	0	2	3	50	50	100
5	19CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
6	19CS1151	Python Programming and Practices	ES	2	0	2	3	50	50	100
		PRACTICAL								
7	19HE1071	Language Competency Enhancement Course - I	HS	0	0	2	1	100	0	100
		MANDATORY COURSES								
8	19HE1072	Career Guidance Level - I	EEC	2	0	0	0	100	0	100
			Total	17	1	8	20	425	375	800
As per AICTE 3 weeks Induction programme is Added in the First Semester as an Audit Course									

SEMESTER II

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE2101	Business English for Engineers	HS	3	0	0	3	25	75	100
2	19MA2101	Differential Equations and Complex Variables	BS	3	1	0	4	25	75	100
3	19AG2104	Principles of Food Sciences	ES	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
4	19PH2151	Material Science	BS	2	0	2	3	50	50	100
5	19CY2151	Environmental studies	BS	2	0	2	3	50	50	100
6	19IT2151	Programming in C	ES	2	0	2	3	50	50	100
PRACTICAL										
7	19ME2001	Engineering Practices	ES	0	0	4	2	50	50	100
8	19HE2071	Language Competency Enhancement Course-II	HS	0	0	2	1	100	0	100
MANDATORY COURSES										
9	19HE2072	Career Guidance Level - II	EEC	2	0	0	0	100	0	100
10	19HE2073	Entrepreneurship and Innovation	EEC	1	0	0	0	100	0	100
			Total	18	1	12	22	575	425	1000

For the students admitted during the academic year 2019-2020 and onwards

SEMESTER III

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA3102	Fourier Analysis and Transforms	BS	3	1	0	4	25	75	100
2	19AG3201	Soil Science and Engineering	PC	3	0	0	3	25	75	100
3	19AG3202	Fluid Mechanics and Hydraulics	PC	3	1	0	4	25	75	100
4	19AG3203	Principles and practices of Crop Production	PC	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
5	19AG3251	Unit Operations in Agricultural Processing	PC	2	0	2	3	50	50	100
PRACTICAL										
6	19AG3001	Field Crop Production Practical	PC	0	0	3	1.5	50	50	100

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
7	19AG3002	Soil Science Laboratory	PC	0	0	3	1.5	50	50	100
		MANDATORY COURSES								
8	19MC3191	Indian Constitution	MC	2	0	0	0	100	0	100
			Total	16	2	8	20	350	450	800

SEMESTER IV

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19AG4201	Farm Tractors	PC	3	0	0	3	25	75	100
2	19AG4202	Thermodynamics	PC	3	0	0	3	25	75	100
3	19AG4203	Irrigation and Drainage Engineering	PC	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
4	19MA4152	Statistics and Numerical Methods	BS	3	0	2	4	50	50	100
5	19AG4251	Bio-Energy Resource Technology	PC	2	0	2	3	50	50	100
6	19AG4252	Surveying and Leveling	PC	2	0	2	3	50	50	100
PRACTICAL										
7	19AG4001	Irrigation Field Lab	PC	0	0	4	2	50	50	100
MANDATORY COURSES										
8	19MC4191	Essence of Indian Traditional Knowledge	MC	2	0	0	0	100	0	100
			Total	18	0	10	21	375	425	800

For the students admitted during the academic year 2018-2019 and onwards

SEMESTER V

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	16AG5201	Refrigeration and Cold Chain Management	PC	3	0	0	3	25	75	100
2	16AG5202	Farm Machinery and Equipment	PC	3	0	0	3	25	75	100
3	16AG5203	Design of Farm Implements and Machinery	PC	3	0	0	3	25	75	100
4	16AG5204	Post Harvest Technology	PC	3	0	0	3	25	75	100

5	16AG53XX	Professional Elective – I	PE	3	0	0	3	25	75	100
PRACTICAL										
6	16AG5001	Operation and Maintenance of Farm Machinery Laboratory	PC	0	0	4	2	50	50	100
7	16AG5002	Post Harvest Engineering Laboratory	PC	0	0	4	2	50	50	100
			Total	15	0	8	19	225	475	700

SEMESTER VI

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	16AG6201	Soil and Water Conservation Engineering	PC	3	0	0	3	25	75	100
2	16AG6202	Food and Dairy Engineering	PC	3	0	0	3	25	75	100
3	16AG6203	Precision Farming and Protected Cultivation	PC	3	0	0	3	25	75	100
4	16AG6204	Bio Energy Resource Technology	PC	3	0	0	3	25	75	100
5	16AG63XX	Professional Elective – II	PE	3	0	0	3	25	75	100
6.	16XX64XX	Open Elective-I	OE	3	0	0	3	25	75	100
PRACTICAL										
7	16AG6001	CAD for Agricultural Engineering	PC	0	0	4	2	50	50	100
8	16AG6002	Drawing of Farm Structures	PC	0	0	4	2	50	50	100
9	16AG6003	Food and Dairy Engineering Laboratory	PC	0	0	4	2	50	50	100
			Total	18	0	12	24	300	600	900

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE – I										
S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	16AG5301	Systems Analysis and Soft Computing in Agricultural Engineering	PC	3	0	0	3	25	75	100

2	16AG5302	Sustainable Agriculture and Food Security	PC	3	0	0	3	25	75	100
3	16AG5303	CDM and Carbon Trading Technology	PC	3	0	0	3	25	75	100
4	16AG5304	IT in Agricultural Systems	PC	3	0	0	3	25	75	100
5	16AG5305	Evapotranspiration and Smart Irrigation	PC	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE – II										
S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	16AG6301	Climate Change and Adaptation	PC	3	0	0	3	25	75	100
2	16AG6302	Heat and Mass Transfers for Agricultural Engineers	PC	3	0	0	3	25	75	100
3	16AG6303	Disaster Management	PC	3	0	0	3	25	75	100
4	16AG6304	Horticultural Crop Processing	PC	3	0	0	3	25	75	100

LIST OF OPEN ELECTIVES
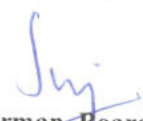
AGRICULTURE ENGINEERING										
S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	16AG6401	Rooftop Gardening and Organic Farming	OE	3	0	0	3	25	75	100

CREDIT DISTRIBUTION – R 2016

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	27	25	25	23	19	24	28	16	187

CREDIT DISTRIBUTION – R 2019

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	22	22	20	18	165

Chairman, Board of Studies

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Dean – Academics

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Principal

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COIMBATORE - 641 0..

SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE1101	TECHNICAL ENGLISH (COMMON TO ALL BRANCHES)	3	0	0	3

Course Objective	• It facilitates students to communicate effectively with coherence. • The student will get trained in descriptive communication. • The trainee will be introduced to professional communication. • It enhances knowledge and provides the information on corporate environment. • The learner will equip with problem solving skills.

Unit	Description	Instructional Hours
I	Listening and Speaking – Opening a conversation, maintaining coherence, turn taking, closing a conversation (excuse, general wishes, positive comments and thanks) Reading –Reading an article from newspaper, Reading comprehension Writing Chart analysis, process description, Writing instructions Grammar and Vocabulary- Tenses, Regular and irregular verb, technical vocabulary	9
II	Listening and Speaking- listening to product description, equipment & work place (purpose, appearance, function) Reading- Reading technical articles Writing- Letter phrases, writing personal letters, Grammar and Vocabulary-articles, Cause & effect, Prepositions.	9
III	Listening and Speaking- - listening to announcements Reading- Reading about technical inventions, research and development Writing- Letter inviting a candidate for interview, Job application and resume preparation Grammar and Vocabulary- Homophones and Homonyms.	9
IV	Listening and Speaking- - Practice telephone skills and telephone etiquette (listening and responding, asking questions).Reading- Reading short texts and memos Writing- invitation letters, accepting an invitation and declining an invitation Grammar and Vocabulary- Modal verbs, Articles, Collocation, Conditionals, Subject verb agreement.	9
V	Listening and Speaking- listening to technical group discussions and participating in GDs Reading- reading biographical writing - Writing- Proposal writing, Writing definitions, Grammar and Vocabulary- Abbreviation and Acronym, Prefixes & suffixes, phrasal verbs, Idioms.	9
	Total Instructional Hours	45

Course Outcome	CO1- Trained to maintain coherence and communicate effectively. CO2- Practiced to create and interpret descriptive communication. CO3- Introduced to gain information of the professional world CO4- acquired various types of communication and etiquette. CO5- Taught to improve interpersonal and intrapersonal skills.

TEXT BOOKS:

T1   Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate",Cambridge University Press,14

T2   Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2013.

REFERENCE BOOKS:

R1   Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press. 2009

R2   Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, 2005.

R3   Kamalesh Sadanan "A Foundation Course for the Speakers of Tamil-Part-I &II", Orient Blackswan,2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA1102	CALCULUS AND LINEAR ALGEBRA (COMMON TO AERO, AUTO, MECH, MECHT, FOOD, AGRI & CIVIL)	3	1	0	4

Course Objective

1. Understand the concept of differentiation.
2. Evaluate the functions of several variables which are needed in many branches of engineering.
3. Understand the concept of double integrals.
4. Understand the concept of triple integrals.
5. Develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.

Unit	Description	Instructional Hours
I	**DIFFERENTIAL CALCULUS** Rolle's Theorem – Lagrange's Mean Value Theorem- Maxima and Minima – Taylor's and Maclaurin's Theorem.	12
II	**MULTIVARIATE CALCULUS (DIFFERENTIATION)** Total derivatives - Jacobians – Maxima, Minima and Saddle points - Lagrange's method of undetermined multipliers – Gradient, divergence, curl and derivatives.	12
III	**DOUBLE INTEGRATION** Double integrals in Cartesian coordinates – Area enclosed by the plane curves (excluding surface area) – Green's Theorem (Simple Application) - Stoke's Theorem – Simple Application involving cubes and rectangular parellopiped.	12
IV	**TRIPLE INTEGRATION** Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates. Gauss Divergence Theorem – Simple Application involving cubes and rectangular parellopiped.	12
V	**MATRICES** Eigen values and Eigen vectors – Properties of Eigen values and Eigen vectors (without proof) - Cayley - Hamilton Theorem (excluding proof) - Reduction of a quadratic form to canonical form by orthogonal transformation.	12
	Total Instructional Hours	60

Course Outcome

CO1: Apply the concept of differentiation in any curve.

CO2: Identify the maximum and minimum values of surfaces.
CO3: Apply double integrals to compute area of plane curves.

CO4: Evaluation of triple integrals to compute volume of solids.
CO5: Calculate Eigen values and Eigen vectors for a matrix which are used to determine the natural frequencies (or Eigen frequencies) of vibration and the shapes of these vibrational modes.

TEXT BOOKS:

T1   Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018.

T2   Veerarajan T, "Engineering Mathematics", McGraw Hill Education (India) Pvt Ltd. New Delhi. 2016.

REFERENCE BOOKS:

R1   Thomas & Finney "Calculus and Analytic Geometry", Sixth Edition,Narosa Publishing House, New Delhi

R2   Bali N.P & Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi Pub. Pvt. Ltd. 2011.

R3   Grewal B.S, "Higher Engineering Mathematics". 42nd Edition, Khanna Publications, Delhi, 2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19ME1101	BASICS OF CIVIL AND MECHANICAL ENGINEERING	3	0	0	3

Course Objective	1. To learn about the working principles of IC engines and detailed explanation of components of power plant units.
	2. To study Refrigeration and Air Conditioning system.
	3. To impart basic knowledge on Civil and Mechanical Engineering
	4. To study materials used for the construction of civil structures.
	5. To gain knowledge on the fundamentals of construction of structure

Unit	Description	Instructional Hours
	A – MECHANICAL ENGINEERING	
I	**IC ENGINES** Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines.	9
II	**POWER PLANT ENGINEERING** Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants – Merits and Demerits –Power Transmission in conveyor systems- Pumps– working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.	9
III	**REFRIGERATION AND AIR CONDITIONING SYSTEM** Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.	9
	B – CIVIL ENGINEERING	
IV	**SURVEYING AND CIVIL ENGINEERING MATERIALS** **Surveying**: Objects – types – classification – principles – measurements of distances **Civil Engineering Materials:** Bricks – stones – sand – cement – concrete – steel sections-Woods-Plastics.	9
V	**BUILDING COMPONENTS AND STRUCTURES** Foundations: Types, Bearing capacity – Requirement of good foundations. Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Types of Bridges and Dams.	9
	Total Instructional Hours	45

COURSE OUTCOMES	Upon completion of the course, the students will be able to CO1: Demonstrate working principles of petrol and diesel engine. CO2: Identify the components used in power plant cycle CO3: Explain the components of Refrigeration and Air conditioning cycle. CO4: Explain the usage of construction material and proper selection of construction materials. CO5: Understand the building structures.

TEXT BOOKS:

T1   Venugopal K. and Prabhu Raja V., ―Basic Mechanical Engineering‖, Anuradha Publishers, Kumbakonam, 2010.

T2   Shanmugam G and Palanichamy M S, ―Basic Civil and Mechanical Engineering‖, Tata MGraw Hill Publishing Co., New Delhi, 2000

REFERENCE BOOKS:

R1   namrutham S., ― Basic Civil Engineering‖, Dhanpat Rai Publishing Co. (P) Ltd.2004.

R2   Seetharaman S., ― Basic Civil Engineering‖, Anuradha Agencies, 2005.

R3   Shantha Kumar S R J., ― Basic Mechanical Engineering‖, Hi-tech Publications,

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Programme B.E.	Course Code	Name of the Course	L	T	P	C
	19PH1151	APPLIED PHYSICS	2	0	2	3

Course Objective	The student should be able to
	1. Enhance the fundamental knowledge in properties of matter
	2. Analysis the oscillatory motions of particles
	3. Extend the knowledge about wave optics
	4. Gain knowledge about laser and their applications
	5. Conversant with principles of optical fiber, types and applications of optical fiber

Unit	Description	Instructional Hours
I	**PROPERTIES OF MATTER** Elasticity – Hooke's law – Stress-strain diagram - Poisson's ratio – Bending moment – Depression of a cantilever – Derivation of Young's modulus of the material of the beam by Uniform bending theory and experiment.	6
	Determination of Young's modulus by uniform bending method	3
II	**OSCILLATONS** Translation motion –Vibration motion – Simple Harmonic motion – Differential Equation of SHM and its solution – Damped harmonic oscillation - Torsion stress and deformations – Torsion pendulum: theory and experiment.	6
	Determination of Rigidity modulus – Torsion pendulum	3
III	**WAVE OPTICS**	6
	Conditions for sustained Interference – air wedge and its applications - Diffraction of light – Fresnel and Fraunhofer diffraction at single slit –Diffraction grating – Rayleigh's criterion of resolution power - resolving power of grating.	
	Determination of wavelength of mercury spectrum – spectrometer grating	3
	Determination of thickness of a thin wire – Air wedge method	3
IV	**LASER AND APPLICATIONS**	6
	Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Derivation of Einstein's coefficients (A&B) – Type of lasers – Nd:YAG laser and CO_2 laser- Laser Applications – Holography – Construction and reconstruction of images.	
	Determination of Wavelength and particle size using Laser	3
V	**FIBER OPTICS AND APPLICATIONS** Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index, modes and materials) – Fiber optical communication link – Fiber optic sensors – Temperature and displacement sensors.	6
	Total Instructional Hours	45

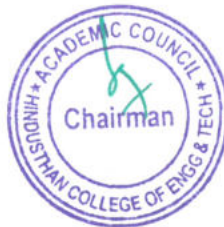| COURSE OUTCOMES	After completion of the course the learner will be able to
	CO1: Illustrate the fundamental properties of matter
	CO2: Discuss the Oscillatory motions of particles
	CO3: Analyze the wavelength of different colors
	CO4: Understand the advanced technology of LASER in the field of Engineering
	CO5: Develop the technology of fiber optical communication in engineering field

TEXT BOOKS:

T1 Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.

T2 Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

R1 Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2015

R2 M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi 2016

R3 Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2016

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Programme	Course Code	Name of the Course	L	T	P	C
BE/B.Tech	19CY1151	CHEMISTRY FOR ENGINEERS (COMMON TO ALL BRANCHES)	2	0	2	3

Course Objective

1. The boiler feed water requirements, related problems and water treatment techniques.
2. The principles of polymer chemistry and engineering applications of polymers and composites.
3. The principles of electrochemistry and with the mechanism of corrosion and its control.
4. The principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
5. The important concepts of spectroscopy and its applications.

Unit	Description	Instructional Hours
I	**WATER TECHNOLOGY** Hard water and soft water- Disadvantages of hard water- Hardness: types of hardness, simple calculations, estimation of hardness of water – EDTA method – Boiler troubles - Conditioning methods of hard water – External conditioning - demineralization process - desalination: definition, reverse osmosis – Potable water treatment – breakpoint chlorination. **Estimation of total, permanent and temporary hardness of water by EDTA.**	6 +3=9
II	**POLYMER & COMPOSITES** Polymerization – types of polymerization – addition and condensation polymerization – mechanism of free radical addition polymerization – copolymers – plastics: classification – thermoplastics and thermosetting plastics, preparation, properties and uses of commercial plastics – PVC, Bakelite – moulding of plastics (extrusion and compression); Composites: definition, types of composites – polymer matrix composites (PMC) –FRP	6
III	**ELECTROCHEMISTRY AND CORROSION** Electrochemical cells – reversible and irreversible cells - EMF- Single electrode potential – Nernst equation (derivation only) – Conductometric titrations. Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types –galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods - protective coatings – paints – constituents and functions. **Conductometric titration of strong acid vs strong base (HCl vs NaOH). Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4. Estimation of Ferrous iron by Potentiometry.**	6+9 =15
IV	**ENERGY SOURCES AND STORAGE DEVICES** Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator-classification of nuclear reactor- light water reactor- breeder reactor. Batteries and fuel cells: Types of batteries- alkaline battery- lead storage battery- lithium battery- fuel cell H_2 -O_2 fuel cell applications.	6
V	**ANALYTICAL TECHNIQUES** Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principle – instrumentation (block diagram only) – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy. **Determination of iron content of the water sample using spectrophotometer.(1,10 phenanthroline / thiocyanate method).**	6+3
	Total Instructional Hours	45

Course Outcome	CO1: Differentiate hard and soft water and to solve the related problems on water purification and its significance in industries and daily life
	CO2: Acquire the basic knowledge of polymers, composites and FRP and their significance.
	CO3: Develop knowledge on the basic principles of electrochemistry and understand the causes of corrosion, its consequences to minimize corrosion to improve industrial design.
	CO4: Develop knowledge about the renewable energy resources and batteries along with the need of new materials to improve energy storage capabilities.
	CO5: Identify the structure and characteristics of unknown/new compound with the help of spectroscopy.

TEXT BOOKS

T1 - P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2018).

REFERENCE BOOKS

R1 - B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2012).

R2 - S.S.Dara "A Text book of Engineering Chemistry" S.Chand & Co. Ltd., New Delhi (2017).

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Programme	Course code	Name of the course	L	T	P	C
B.E.	19CS1151	PYTHON PROGRAMMING AND PRACTICES	2	0	2	3

COURSE OBJECTIVES

1. To know the basics of algorithmic problem solving
2. To read and write simple Python programs
3. To develop Python programs with conditionals and loops and to define Python functions and call them
4. To use Python data structures — lists, tuples, dictionaries
5. To do input/output with files in Python

Unit	Description	Instructional hours
I	**ALGORITHMIC PROBLEM SOLVING** Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation(pseudo code, flow chart, programming language), algorithmic problem solving, simple strategiesfor developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert acard in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.	9
II	**DATA, EXPRESSIONS, STATEMENTS** Python interpreter and interactive mode; values and types: int, float, boolean, string, and list;variables, expressions, statements, tuple assignment, precedence of operators, comments;modules and functions, function definition and use, flow of execution, parameters and arguments. Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.	7+2(P)
III	**CONTROL FLOW, FUNCTIONS** Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: returnvalues, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.	5+4(P)
IV	**LISTS, TUPLES, DICTIONARIES** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters: Tuples: tuple assignment, tuple as return value; Dictionaries: operations andmethods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.	3+6(P)
V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, format operator; command line arguments,errors and exceptions, handling exceptions, modules, packages. Illustrative programs: word count, copying file contents.	5+4(P)
	Total instructional hours	45

COURSE OUTCOMES	After the completion of the course, the learner will be able to CO1 - Develop algorithmic solutions to simple computational problems CO2 - Read, write, execute by hand simple Python programs CO3 - Structure simple Python programs for solving problems and Decompose a Python program into functions CO4 - Represent compound data using Python lists, tuples, dictionaries CO5 - Read and write data from/to files in Python Programs.

TEXT BOOKS:

T1   Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised andupdated for Python 3.6.2, Shroff Publishers, First edition (2017).

T2   S. Annadurai, S.Shankar, I.Jasmine, M.Revathi, Fundamentals of Python Programming, Mc-Graw Hill Education (India) Private Ltd, 2019

REFERENCE BOOKS:

R1:   Charles Dierbach, —Introduction to Computer Science using Python: A ComputationalProblem-Solving Focus, Wiley India Edition, 2013.

R2:   Timothy A. Budd, —Exploring Pythonl, Mc-Graw Hill Education (India) Private Ltd., 2015

R3:   Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming inPython: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE1071	LANGUAGE COMPETENCY ENHANCEMENT COURSE- I	0	0	2	1

(COMMON TO ALL BRANCHES)

Course Objective	✓ To enhance student language competency ✓ To train the students in LSRW skills ✓ To develop student communication skills ✓ To empower the trainee in business writing skills. ✓ To train the students to react to different professional situations

Unit	Description	Instructional Hours
I	**Listening** Listening to technical group discussions and participating in GDs. listening to TED talks. Listen to Interviews & mock interview. Listening short texts and memos.	3
II	**Reading** Reading articles from newspaper, magazine. Reading comprehension. Reading about technical inventions, research and development. Reading short texts and memos.	3
III	**Writing** E-mail writing: Create and send email writing (to enquire about some details, to convey important message to all, to place an order, to share your joy and sad moment). Reply for an email writing.	3
IV	**Speaking** To present a seminar in a specific topic (what is important while choosing or deciding something to do). To respond or answer for general questions (answer for your personal details, about your family, education, your hobbies, your aim etc.,).	3
V	**Speaking** Participate in discussion or interactions (agree or disagree express your statement with a valid reason, involve in discussion to express your perspective on a particular topics).	3
	Total Instructional Hours	15

Course Outcome	CO1- Trained to maintain coherence and communicate effectively. CO2- Practiced to create and interpret descriptive communication. CO3- Introduced to gain information of the professional world. CO4- acquired various types of communication and etiquette. CO5- Taught to improve interpersonal and intrapersonal skills.

TEXT BOOKS:

T1   Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016.

T2   Raymond Murphy, "Essential English Grammar", Cambridge University Press, 2019

REFERENCE BOOKS:

R1:   Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.

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Programme	Course code	Course title	L	T	P	C
B.E.	19HE1072	**CAREER GUIDANCE – LEVEL I** **Personality, Aptitude and Career Development**	2	0	0	0

Course Objectives:

- Introduce students to building blocks of Logical reasoning and Quantitative Aptitude [SLO 1]
- Train students on essential grammar for placements [SLO 2]
- Introduce students on scientific techniques to pick up skills [SLO 3]
- Provide an orientation for recruiter expectation in terms of non-verbal skills, and for how to build one's career with placements in mind [SLO 4]

Expected Course Outcome:

Enable students to approach learning Aptitude with ease, and understand recruiter expectation.

Student Learning Outcomes (SLO):   1, 2, 3 and 4

Module:1	Lessons on excellence	2hours	SLO:3

Skill introspection, Skill acquisition, consistent practice

Module:2	Logical Reasoning	11 hours	SLO:1

Thinking Skill
- Problem Solving
- Critical Thinking
- Lateral Thinking

Taught through thought-provoking word and rebus puzzles, and word-link builder questions

Coding & decoding, Series, Analogy, Odd man out and Visual reasoning
- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

Sudoku puzzles

Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfort with numbers

Attention to detail

Picture and word driven Qs to develop attention to detail as a skill

Module:3	Quantitative Aptitude	11 hours	SLO:1

Speed Maths
- Addition and Subtraction of bigger numbers
- Square and square roots
- Cubes and cube roots
- Vedic maths techniques
- Multiplication Shortcuts
- Multiplication of 3 and higher digit numbers
- Simplifications
- Comparing fractions
- Shortcuts to find HCF and LCM
- Divisibility tests shortcuts

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Algebra and functions

Module:4   **Recruitment Essentials**   **2hours**   SLO:4
Looking at an engineering career through the prism of an effective resume

- Importance of a resume - the footprint of a person's career achievements
- How a resume looks like?
- An effective resume vs. a poor resume: what skills you must build starting today and how?

Impression Management

Getting it right for the interview:

- Grooming, dressing
- Body Language and other non-verbal signs
- Displaying the right behaviour

Module:5   Verbal Ability   **4hours**   SLO:2
Essential grammar for placements:

- Nouns and Pronouns
- Verbs
- Subject-Verb Agreement
- Pronoun-Antecedent Agreement
- Punctuations

Verbal Reasoning

                                            Total Lecture hours   30hours

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE2101	BUSINESS ENGLISH FOR ENGINEERS	3	0	0	3

Course Objective	
	1. The learner gets started with business communication.
	2. It trains the students to react to different professional situations.
	3. The student will get familiarize to managerial skills
	4. It empowers business writing skills.
	5. The trainee will learn to interpret and expertise different content.

Unit	Description	Instructional Hours
I	**Listening and Speaking** – listening and discussing about programme and conference arrangement **Reading** –reading auto biographies of successful personalities **Writing** Formal & informal email writing, Recommendations **Grammar and Vocabulary-** Editing a passage(punctuation and spelling), Adjectives & adverbs	9
II	**Listening and Speaking-** listening to TED talks **Reading-** Making and interpretation of posters **Writing-** Business letters: letters giving good and bad news, Thank you letter, Grateful & pleased **Grammar and Vocabulary-** Active & passive voice, Spotting errors (Teses, , Preposition, Articles)	9
III	**Listening and Speaking-**travel arrangements and experience **Reading-** travel reviews **Writing-** Business letters (Placing an order, making clarification & complaint letters). **Grammar and Vocabulary-** Direct and Indirect speech,	9
IV	**Listening and Speaking-** Role play - **Reading-** Sequencing of sentence **Writing-** Business report writing (marketing, investigating) **Grammar and Vocabulary-** Connectors, Gerund & infinitive	9
V	**Listening and Speaking-** Listen to Interviews & mock interview **Reading-** Reading short stories, reading profile of a company - **Writing-** Descriptive writing (describing one's own experience) **Grammar and Vocabulary-** Business vocabulary.	9
	Total Instructional Hours	45

COURSE OUTCOMES	
	After the completion of the course, the learner will be able to
	CO1:Introduced to different modes and types of business communication.
	CO2: Practiced to face and react to various professional situations efficiently.
	CO3: learnt to practice managerial skills.
	CO4: Familiarized with proper guidance to business writing.
	CO5: Trained to analyze and respond to different types of communication

TEXT BOOKS:

T1   Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate",Cambridge University Press, 2014.)

T2   Michael Mc Carthy, "Grammar for Business", Cambridge University Press, 2009

REFERENCE BOOKS:

R1   Rajeevan kaval. "English Grammar just for you", Oxford University Press 2015.

R2   Bill Mascull, "Business Vocabulary in use: Advanced 2nd Edition", Cambridge University Press, 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
		DIFFERENTIAL EQUATIONS AND COMPLEX				
B.E.	19MA2101	**VARIABLES**	3	1	0	4
		(AERO, AUTO, MCT, MECH, CIVIL, FT & AGRI)				

Course Objectives	1. Describe some methods to solve different types of first order differential equations.
	2. Solve ordinary differential equations of certain types using Wronskian technique.
	3. Use the effective mathematical tools for the solutions of partial differential equations.
	4. Describe the construction of analytic functions and conformal mapping.
	5. Illustrate Cauchy's integral theorem and calculus of residues

Unit	Description	Instructional Hours
I	**FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS** Equations of the first order and of the first degree – Homogeneous equations – Exact differential equations – Linear equations – Equations reducible to the linear form – Bernoulli's equation.	12
II	**ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER** Second order linear differential equations with constant and variable co-efficients – Cauchy – Euler equations – Cauchy – Legendre equation – Method of variation of paramers.	12
III	**PARTIAL DIFFERENTIAL EQUATIONS** Formation of partial differential equations by the elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations of the form $f(p,q)=0$, Clairaut's type : $z = px+qy +f(p,q)$ – Lagrange's linear equation.	12
IV	**COMPLEX DIFFERENTIATION** Functions of complex variables – Analytic functions – Cauchy's – Riemann's equations and sufficient conditions (excluding proof) – Construction of analytic functions – Milne –Thomson's method – Conformal mapping $w = A+z$, Az, $1/z$ and bilinear transformations.	12
V	**COMPLEX INTEGRATION** Cauchy's integral theorem – Cauchy's integral formula –Taylor's and Laurent's series (statement only) –Residues - Cauchy's Residue theorem.	12

Total Instructional Hours	45+15

COURSE OUTCOMES	CO1: Apply few methods to solve different types of first order differential equations.
	CO2: Develop sound knowledge of techniques in solving ordinary differential equations.
	CO3 Solve Partial Differential Equations using various methods.
	CO4: Infer the knowledge of construction of analytic functions and conformal mapping.
	CO5: Evaluate real and complex integrals over suitable closed paths or contours.

TEXT BOOKS:

T1   Ravish R Singh, Mukul Bhatt, "Engineeing Mathematics", McGraw Hill education (India) Private Ltd.,Chennai,2017.

T2   Veerarajan T, "Engineering Mathematics", McGraw Hill Education(India) Pvt Ltd, New Delhi, 2016

REFERENCE BOOKS:

R1   Bali N.P & Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi Pub. Pvt. Ltd. 2011.

R2   Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.

R3   Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning.2012.

R4   Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley and Sons, 2006.

R5   Wylie & Barett, "Advanced Engineering Mathematics", McGraw Hill Education, 6th edition, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG2104	**PRINCIPLES OF FOOD SCIENCE**	3	0	0	3

Course Objectives	1. To give Introduction on Food Science 2. To understand various cooking methods. 3. To learn about cooking qualities 4. To Study about food additives and quality tests

Unit	Description	Instructional Hours
I	**Introduction to Food Science** Definition of food. Nutrients - macro and micro constituents. Functions of foods. Food groups. Food Science - Definition - objectives and applications.	9
II	**Methods of cooking and sensory evaluation of foods** Methods of cooking - moist heat, dry heat and combination methods. Nutrient losses during cooking and processing. Sensory evaluation of foods - methods and applications.	9
III	**Cooking qualities of foods** Nutritive value, Factors affecting during cooking of foods- Cereals, pulses, nuts and oilseeds, vegetables, milk, meat, fish, egg and poultry. Spices and condiments – types – use in cookery	9
IV	**Properties of foods** Gelatinization, denaturation, colloids, emulsion, foam, sol, gel, fermentation, crystallization, enzymatic and non - enzymatic browning of foods. Antinutritional factors in foods	9
V	**Food additives** Classification and role - preservatives, antioxidants, chelating agents, flour improvers, artificial sweeteners, flavours, colours, nutrient enhancement, stabilizers, emulsifier firming agent, leavening and releasing agent. Food fortification - enrichment - need - application in foods. Cooking quality tests - cereals, pulses, vegetables, meat, poultry and fish - Gelatinization of starch - Denaturation of protein, stages of sugar cookery – formation of emulsion - enzymatic and non-enzymatic browning. Leavening agents - clarifying agents - foam and its stability. Food enrichment.	9

	Total Instructional Hours	**45**

COURSE OUTCOMES	The students completing the course will have: CO1: The students will be able to learn about food science, cooking methods and its quality CO2: The students will be able to identify the preservation techniques in various food. CO3: Understand the importance of Cooking qualities of foods CO4: Understand the Properties of foods and its role CO5: Understand the Classification and role food additives.

TEXT BOOKS:

T1	Potter, N. 2005. Food Science, CBS Publishers and Distributors, Delhi.
T2	Srilakshmi, B. 2005. Food Science. New Age International (P) Ltd., Publishers, New Delhi

REFERENCE BOOKS:

R1   Benion, M. 1970. Introductory Foods, 8th Edn., The MacMillan Co.London

R2   Swaminathan, M. 1995. Food Science and Experimental Foods, Ganesh and Co., Madras.

R3   Bernard, W.M. 1997. Chocolate, cocoa and confectionery: Science and Technology (Third Edition) CBS Publishers and distributors, New Delhi.

R4   Meyer, L.H. 1991, Food Chemistry, Affiliated East-West Press Pvt.Ltd., New Delhi.

R5   Desrosier, N.W. and J.N. Desrosier. 2002.The technology of food preservation (4th edition). CBS Publishers and Distributors. New Delhi.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19PH2151	MATERIAL SCIENCE	2	0	2	3

Course Objective	The student should be able to 1. Acquire fundamental knowledge of semiconducting materials which is related to the 2. engineering program 3. Extend the knowledge about the magnetic materials 4. Explore the behavior of super conducting materials 5. Gain knowledge about Crystal systems 6. Understand the importance of ultrasonic waves

Unit	Description	Instructional Hours
I	**SEMICONDUCTING MATERIALS** Introduction – Intrinsic semiconductor – Compound and elemental semiconductor - direct and indirect band gap of semiconductors. Carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination. Optical properties of semiconductor – Light through optical fiber(Qualitative).	6
	Determination of band gap of a semiconductor	3
	Determination of acceptance angle and numerical aperature in an optical fiber	3
II	**MAGNETIC MATERIALS** Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti ferromagnetic materials – Ferrites and its applications.	6
	B – H curve by Magnetic hysteresis experiment	3
III	**SUPERCONDUCTING MATERIALS** Superconductivity: properties(Messiner effect, effect of magnetic field, effect of current and isotope effects) – Type I and Type II superconductors –High Tc superconductors – Applications of superconductors –Cryotron and magnetic levitation.	6
IV	**CRYSTAL PHYSICS** Crystal systems - Bravais lattice - Lattice planes - Miller indices - Interplanar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures.	6
V	**ULTRASONICS** Production – Magnetostrictive generator – Piezoelectric generator – Determination of velocity using acoustic grating – Cavitations – Viscous force – co-efficient of viscosity. Industrial applications – Drilling and welding – Non destructive testing – Ultrasonic pulse echo system.	6
	Determination of velocity of sound and compressibility of liquid – Ultrasonic wave	3
	Determination of Coefficient of viscosity of a liquid –Poiseuille's method	3

Total Instructional Hours	**45**

	After completion of the course the learner will be able to
COURSE OUTCOMES	CO1: Understand the purpose of acceptor or donor levels and the band gap of a semiconductor
	CO2: Interpret the basic idea behind the process of magnetism and its applications in everyday
	CO3: Discuss the behavior of super conducting materials
	CO4: Illustrate the types and importance of crystal systems
	CO5: Evaluate the production of ultrasonics and its applications in NDT

TEXT BOOKS:

T1   Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.

T2   T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

R1   Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2015

R2   M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi 2016

R3   Dr. G. Senthilkumar "Engineering Physics – II" VRB publishers Pvt Ltd., 2016

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19CY2151	ENVIRONMENTAL STUDIES	2	0	2	3

Course Objective

1. To study about the natural resources, exploitation and its conservation
2. To gain knowledge on the importance of environmental education, ecosystem and biodiversity.
3. To acquire knowledge about environmental pollution – sources, effects and control measures of environmental pollution.
4. To find and implement scientific, technological, economic and political solutions to environmental problems.
5. To be aware of the national and international concern for environment and its protection.

Unit	Description	Instructional Hours
I	**NATURAL RESOURCES** Renewable and Non-renewable resources - Forest resources: Use and over-exploitation, deforestation, timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture – Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and Desertification- role of an individual in conservation of natural resources.	6
II	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY** Importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem - energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: types and value of biodiversity – hot-spots of biodiversity – threats to biodiversity– endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.	6
III	**ENVIRONMENTAL POLLUTION** Definition – causes, effects and control measures of: Air pollution- Water pollution – Water quality parameters- Soil pollution - Noise pollution- Marine pollution - Nuclear hazards – role of an individual in prevention of pollution	6
IV	**SOCIAL ISSUES AND THE ENVIRONMENT** From unsustainable to sustainable development – urban problems related to energy- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- Current Environmental issues at Country level – management of municipal solid waste. Global issues – Climatic change, acid rain, greenhouse effect and ozone layer depletion – Disaster Management.	6

HUMAN POPULATION AND THE ENVIRONMENT

V   Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- GIS-remote sensing-role of information technology in environment and human health – Case studies.   6

Total Instructional Hours   45

COURSE OUTCOMES	After completion of the course the learner will be able to CO1: Develop an understanding of different natural resources including renewable resources. CO2: Realise the importance of ecosystem and biodiversity for maintaining ecological balance. CO3: Understand the causes of environmental pollution and hazards due to manmade activities. CO4: Demonstrate an appreciation for need for sustainable development and understand the various social issues and solutions to solve the issues. CO5: Gain knowledge about the importance of women and child education and know about the existing technology to protect environment

TEXT BOOKS:

T1   Anubha Kaushik and C. P. Kaushik, "Environmental Science and Engineering", Fourth edition, New Age

T2   S.Annadurai and P.N. Magudeswaran, "Environmental studies", Cengage Learning India Pvt.Ltd, Delhi, 2018

REFERENCE BOOKS:

R1   Erach Bharucha, "Textbook of environmental studies" University Press (I) Pvt.ltd, Hyderabad, 2015

R2   G.Tyler Miller, Jr and Scott E. Spoolman"Environmental Science" Thirteenth Edition, Cengage Learning, 2010.

R3   Gilbert M. Masters and Wendell P. Ela "Introduction to Environmental Engineering and Science", 3rd edition, Pearson Education, 2013

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Programme	Course code	Name of the course	L	T	P	C
B.E.	19IT2151	PROGRAMMING IN C	2	0	2	3

Course objectives	
	1. To develop C Programs using Basic programming constructs
	2. To develop C programs using Arrays and Strings
	3. To develop applications in C using Functions, Pointers and Structures
	4. To do Input / Output and File handling in C
	5. To develop C Programs using Basic programming constructs

Unit	Description	Instructional hours
I	**Basics of C Programming**	
	Structure of C program - C programming: Data Types –Keywords – Variables - Operators: Precedence and Associativity - Expressions – Input / Output statements Decision making statements - Looping statements – Pre-processor directives - Compilation process	5+4(P)
	Programs using decision - making and Looping Constructs.	
II	**Arrays And Strings**	
	Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays – String operations and String functions	5+4(P)
	Programs Using Arrays and string functions.	
III	**Functions And Pointers**	
	Introduction to functions: Function prototype, function definition, function call - Parameter passing: Pass by value, Pass by reference – Recursion – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers — Pointer to pointers – pointer to strings	5+4(P)
	Programs Using Functions and Pointers	
	Structures and Unions	
IV	Structure - Nested structures – Pointer to Structures – Array of structures – Self-referential structures – Dynamic memory allocation – Typedef-Unions – Union of Structures	7+2(P)
	Programs Using Structures and Unions.	
V	**File Processing**	
	Files – Types of file processing: Sequential access, Random access – Sequential access file - Random access file – Command line arguments	7+2(P)
	Programs Using File concepts	
	Total instructional hours	45

| COURSE OUTCOMES | After completion of the course the learner will be able to
CO1 - Select appropriate data types and control structures for solving a given problem.
CO2 - Develop applications using arrays and strings
CO3 - Understand the importance of functions, pointers and dynamic memory allocation.
CO4 - Understand the Concepts of structures to develop applications in C using |
|---|---|

TEXT BOOKS:

T1   . Balagurusamy – "Programming in ANSI C", Tata McGraw Hill, 7th Edition,201. ISBN 13:

T2   ReemaThareja, — "Programming in C", Oxford University Press, Second Edition, 2016. ISBN

REFERENCE BOOKS:

R1   Ashok.N.Kamthane,RajKamal ," Computer Programming and IT", Pearson Education (India),2012, ISBN -9788131799604

R2   Paul Deitel and Harvey Deitel, —"C How to Program", Eighth edition,2012, Pearson PublicationISBN– 9780132990448

R3   Kernighan, B.W and Ritchie,D.M, —The C Programming language, Second Edition, Pearson Education, 2012 ISBN 13: 9789332549449

R4   Yashavant P. Kane tkar. " Let Us C", BPB Publications, 15th Edition , July 201, ISBN-13:978- 8183331630

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Programme B.E.	Name of the Course	L	T	P	C
	19ME2001 ENGINEERING PRACTICES	0	0	4	2

Course Objective

To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical and Electrical Engineering.

GROUP A (CIVIL & MECHANICAL)

S.No	Description of the Experiments

CIVIL AND MECHANICAL ENGINEERING PRACTICES

1	Preparation of Single pipe line and Double pipe line connection by using valves, taps, couplings, unions, reducers and elbows.
2	Arrangement of bricks using English Bond for one brick thick wall for right angle corner junction and T- junction
3	Arrangement of bricks using English Bond for one and a half brick thick wall for right angle corner and T- junction
4	Preparation of arc welding of Butt joints, Lap joints and Tee joints.
5	Practice on sheet metal Models– Trays and funnels
6	Hands-on-exercise in wood work, joints by sawing, planning and cutting.
7	Practice on simple step turning, taper turning and drilling.
8	Demonstration on Smithy operation.
9	Demonstration on Foundry operation.
10	Demonstration on Power tools.

GROUP B (ELECTRICAL)

S.No	Description of the Experiments

ELECTRICAL ENGINEERING PRACTICES

1	Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2	Fluorescent lamp wiring.
3	Stair case wiring.
4	Measurement of Electrical quantities – voltage, current, power & power factor in single phase circuits.
5	Measurement of energy using single phase energy meter.
6	Soldering practice using general purpose PCB.
7	Measurement of Time, Frequency and Peak Value of an Alternating Quantity using CRO and Function Generator.
8	Study of Energy Efficient Equipment's and Measuring Instruments.

Total Practical Hours 45

COURSE OUTCOMES	After completion of the course the learner will be able to CO1:Fabricate wooden components and pipe connections including plumbing works. CO2:Fabricate simple weld joints. CO3:Fabricate different electrical wiring circuits and understand the AC Circuits. CO4:Determine the level of DO in a water sample. CO5:Identify and estimate the different types of alkalinity in water sample. CO6:Estimate the amount of copper in a water sample. CO7:Determine the metal ion content using instrumental methods

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE2071	LANGUAGE COMPETENCY ENHANCEMENT COURSE- II	0	0	2	1
		(COMMON TO ALL BRANCHES)				

Course Objective	✓ To introduce to business communication.
	✓ To train the students to react to different professional situations.
	✓ To make the learner familiar with the managerial skills
	✓ To empower the trainee in business writing skills.
	✓ To learn to interpret and expertise different content.

Unit	Description	Instructional Hours
I	**Listening and Speaking** – listening and discussing about programme and conference arrangement **Reading** –reading auto biographies of successful personalities **Writing** Formal & informal email writing, Recommendations **Grammar and Vocabulary-** Business vocabulary, Adjectives & adverbs.	3
II	**Listening and Speaking-** listening to TED talks **Reading-** Making and interpretation of posters **Writing-** Business letters: letters giving good and bad news, Thank you letter, Congratulating someone on a success" **Grammar and Vocabulary-** Active & passive voice, Spotting errors (Tenses, Preposition, Articles).	3
III	**Listening and Speaking-**travel arrangements and experience **Reading-** travel reviews **Writing-** Business letters (Placing an order, making clarification & complaint letters). **Grammar and Vocabulary-** Direct and Indirect speech.	3
IV	**Listening and Speaking-** Role play - **Reading-** Sequencing of sentence **Writing-** Business report writing (marketing, investigating) **Grammar and Vocabulary-** Connectors, Gerund & infinitive.	3
V	**Listening and Speaking-** Listen to Interviews & mock interview **Reading-** Reading short stories, reading profile of a company - **Writing-** Descriptive writing (describing one's own experience) **Grammar and Vocabulary-** Editing a passage(punctuation, spelling & number rules).	3
	Total Instructional Hours	15

Course Outcome	CO1- Introduced to different modes and types of business communication.
	CO2- Practiced to face and react to various professional situations efficiently.
	CO3- learnt to practice managerial skills.
	CO4- Familiarized with proper guidance to business writing.
	CO5- Trained to analyze and respond to different types of communication.

TEXT BOOKS:

T1   Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate",Cambridge University Press, 2016.

T2   Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2015.

REFERENCE BOOKS:

R1   Michael Mc Carthy, "Grammar for Business", Cambridge University Press, 2009.

R2   Bill Mascull, "Business Vocabulary in use: Advanced 2nd Edition", Cambridge University Press, 2009.

R3   Frederick T. Wood. "Remedial English Grammar For Foreign Students", Macmillan publishers, 2001.

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Programme	Course code	Course title	L	T	P	C
B.E.	19HE2072	**CAREER GUIDANCE LEVEL - II** Personality, Aptitude and Career Development	2	0	0	0

Course Objectives:
- Solve Logical Reasoning questions of easy to intermediate level [SLO 6]
- Solve Quantitative Aptitude questions of easy to intermediate level [SLO 7]
- Solve Verbal Ability questions of easy to intermediate level [SLO 8]

Expected Course Outcome:
Enable students to solve questions on Verbal, Logical and Quantitative Aptitude of placement level

Student Learning Outcomes (SLO):   6, 7, 8

Module:1	**Logical Reasoning**	8 hours		SLO:6

Word group categorization questions
Puzzle type class involving students grouping words into right group orders of logical sense

Cryptarithmetic
Data arrangements and Blood relations
- Linear Arrangement
- Circular Arrangement
- Multi-dimensional Arrangement
- Blood Relations

Module:2	**Quantitative Aptitude**	12 hours		SLO:7

Ratio and Proportion
- Ratio
- Proportion
- Variation
- Simple equations
- Problems on Ages
- Mixtures and alligations

Percentages, Simple and Compound Interest
- Percentages as Fractions and Decimals
- Percentage Increase / Decrease
- Simple Interest
- Compound Interest
- Relation Between Simple and Compound Interest

Number System
- Number system
- Power cycle
- Remainder cycle
- Factors, Multiples
- HCF and LCM

Module:3	**Verbal Ability**	10hours		SLO:8

Essential grammar for placements
- Prepositions
- Adjectives and Adverbs
- Tenses
- Forms and Speech and Voice

- Idioms and Phrasal Verbs
- Collocations, Gerund and Infinitives

Reading Comprehension for placements
- Types of questions
- Comprehension strategies
- Practice exercises

Articles, Prepositions and Interrogatives
- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

Vocabulary for placements
- Exposure to solving questions of
- Synonyms
- Antonyms
- Analogy
- Confusing words
- Spelling correctness

Total Lecture hours: 30hours

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE2073	Entrepreneurship & Innovation	1	0	0	0

Course Objective`

1. To acquire the knowledge and skills needed to manage the development of innovation.
2. To recognize and evaluate potential opportunities to monetize these innovations.
3. To plan specific and detailed method to exploit these opportunities.
4. To acquire the resources necessary to implement these plans.
5. To make students understand organizational performance and its importance.

Module	Description	Instructional Hours
1.	Entrepreneurial Thinking	
2.	Innovation Management	
3.	Design Thinking	
4.	Opportunity Spotting / Opportunity Evaluation	
5.	Industry and Market Research	
6.	Innovation Strategy and Business Models	
7.	Financial Forecasting	
8.	Business Plans/ Business Model Canvas	
9.	Entrepreneurial Finance	
10.	Pitching to Resources Providers / Pitch Deck	
11.	Negotiating Deals	
12.	New Venture Creation	
13.	Lean Start-ups	
14.	Entrepreneurial Ecosystem	
15.	Velocity Venture	

Total Instructional Hours   15

Course Outcome

CO1: Understand the nature of business opportunities, resources, and industries in critical and creative aspects.
CO2: Understand the processes by which innovation is fostered, managed, and commercialized.
CO3: Remember effectively and efficiently the potential of new business opportunities.
CO4: Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness.
CO5: Develop a business model for a new venture, including revenue. Margins, operations, working capital, and investment.

TEXT BOOKS:

T1: Arya Kumar "Entrepreneurship – Creating and leading an Entrepreneurial Organization", Pearson, Second Edition (2012).
T2: Emrah Yayici "Design Thinking Methodology", Artbiztech, First Edition (2016).

REFERENCE BOOKS:

R1: Christopher Golis "Enterprise & Venture Capital", Allen & Unwin Publication, Fourth Edition 2007
R2: Thomas Lock Wood & Edger Papke "Innovation by Design", Career Press.com, Second (2017).
R3: Jonahan Wilson "Essentials of Business Research", Sage Publication, First Edition, (2010).

WEB RESOURCES:

W1: https://blof.forgeforward.in/tagged/startup-lessons

W2: https://blof.forgeforward.in/tagged/entrepreurship

W3: https://blof.forgeforward.in/tagged/minimum-viable-product

W4: https://blof.forgeforward.in/tagged/minimum-viable-product

W5: https://blof.forgeforward.in/tagged/innovation

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA3102	**FOURIER ANALYSIS AND TRANSFORMS** (EEE, ECE, E&I, AGRI, BIO MEDICAL & FOOD TECHNOLOGY)	3	1	0	4

Course Objective	1. Analyze Fourier series which is central to many applications in engineering. 2. Apply the effective tools for the solutions of one-dimensional boundary value problems. 3. Apply the effective tools for the solutions of two dimensional heat equations. 4. Apply Fourier transform techniques in various situations. 5. Analyze Z transform techniques for discrete time systems.

Unit	Description	Instructional Hours
I	**FOURIER SERIES** Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Half range sine and cosine series – Change of Interval - Parseval's Identity - Harmonic analysis.	12
II	**BOUNDARY VALUE PROBLEMS** Classification of PDE - Solutions of one-dimensional wave equation - One dimensional equation of heat conduction (excluding insulated edges).	12
III	**TWO-DIMENSIONAL HEAT EQUATIONS** Steady state solution of two-dimensional equation of heat conduction in infinite plate and semi circular plate.	12
IV	**FOURIER TRANSFORMS** Fourier Transform Pairs - Fourier sine and cosine transforms – Properties - Transforms of Simple functions – Convolution Theorem (Statement only) – Parseval's identity(Statement only).	12
V	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS** Z- Transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem (excluding proof)– Solution of difference equations using Z – transform.	12
	Total Instructional Hours	60

After completion of the course the learner will be able to

COURSE OUTCOMES

CO1: Understand the principles of Fourier series which helps them to solve physical problems of engineering.

CO2: Employ Fourier series in solving the boundary value problems.

CO3: Understand Fourier series in solving the two dimensional heat equations.

CO4: Apply Fourier transform techniques which extend its applications.

CO5: Illustrate the Z- transforms for analyzing discrete-time signals and systems

TEXT BOOKS:

T1   Veerarajan. T.,"Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Second reprint, New Delhi, 2012.

T2   Bali. N.P and Manish Goyal & Watkins, "Advanced Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007

REFERENCE BOOKS:

R1   C.Roy Wylie " Advance Engineering Mathematics" Louis C. Barret, 6th Edition, Mc Graw Hill Education India Private Limited, New Delhi 2003

R2   Kandasamy P., Thilagavathy K. and Gunavathy K.,"Engineering Mathematics Volume III", S.Chand & Company Ltd., New Delhi, 1996.

R3   Grewal B.S.. "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi,2018.

R4   Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG3201	SOIL SCIENCE AND ENGINEERING	3	0	0	3

Course Objective	• To expose the students to the fundamental knowledge on Soil physical parameters, • To learn about Permeability – Compaction, Bearing Capacity and types and methods of soil survey and interpretative groupings

Unit	Description	Instructional Hours
I	**INTRODUCTION AND SOIL PHYSICS** Soil - definition - major components –Soil forming minerals and processes- soil profile -Physical properties - texture –density-porosity-consistence-colour- -specific gravity - capillary and non-capillary -plasticity. Soil air - soil temperature - soil water - classification of soil water- Movement soil water. Soil colloids – organic and inorganic matter-Ion exchange- pH – Plant nutrient availability	9
II	**SOIL CLASSIFICATION AND SURVEY** Soil taxonomy – Soils of Tamil Nadu and India. Soil survey - types and methods of soil survey – Field mapping- mapping units - base maps -preparation of survey reports - concepts and uses - land capability classes and subclasses - soil suitability -Problem soils – Reclamation.	9
III	**PHASE RELATIONSHIP AND SOIL COMPACTION** Phase relations- Gradation analysis- Atterberg Limits and Indices- Engineering Classification of soil – Soil compaction- factors affecting compaction- field and laboratory methods.	9
IV	**ENGINEERING PROPERTIES OF SOIL** Shear strength of cohesive and cohesionless - Mohr-Coulomb failure theory- Measurement of shear strength, direct shear, Triaxial and vane shear test- -Permeability- Coefficient of Permeability- Darcy's law-field and lab methods - Assessment of seepage - Compressibility	9
V	**BEARING CAPACITY AND SLOPE STABILITY** Bearing capacity of soils - Factors affecting Bearing Capacity- Shallow foundations-Terzaghi"s formula- BIS standards - Slope stability-Analysis of infinite and finite slopes- friction circle method-slope protection measures.	9
	Total Instructional Hours	45

COURSE OUTCOMES	After completion of the course the learner will be able to CO1:Fundamental knowledge of soil physical parameters. CO2:The procedures involved in soil survey, soil classification. CO3:The phase relationship and soil compaction. CO4:Concepts of bearing capacity and slope stability CO5: Understanding the important of BIS standards

TEXT BOOKS:

T1   Nyle C. Brady, "The Nature and Properties of Soil", Macmillan Publishing Company, 10th Edition, New York, 2008

| T2 | Punmia, B.C., "Soil Mechanics and Foundation "Laxmi Publishers, New Delhi, 2007. |

REFERENCE BOOKS:

R1	Edward J. Plaster., "Soil Science", Cengage Learning India Ltd, New Delhi, 2009.
R2	Arora, K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 2007
R3	Murthy, V.N.S. "Soil Mechanics and Foundation Engineering", UBS Publishers and Distributors, New Delhi, 2007
R4	Sehgal, S.B., "Text Book of Soil Mechanics", CBS Publishers and Distributors New Delhi, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG3202	FLUID MECHANICS AND HYDRAULICS	3	1	0	4

Course Objective	1. To understand the properties of fluids 2. To acquire knowledge on fluid flow 3. To understand the behavior of fluid flow through pipes 4. To gain knowledge on open channel flows 5. To gather knowledge on dimensional analysis and study the various types of pumps

Unit	Description	Instructional Hours
I	**PROPERTIES OF FLUIDS** Properties of fluids – definition – units of measurement - Mass density – specific weight, specific volume – specific gravity - equation of state – perfect gas - Viscosity – vapour pressure – compressibility and elasticity - surface tension – capillarity. Fluid pressure and measurement – simple, differential and micro manometers - Mechanical gauges – calibration. Hydrostatic forces on surfaces – total pressure and centre of pressure – Horizontal - Vertical and Inclined plane surface - Pressure diagram – total pressure on curved surface. Archimedes principles –buoyancy - metacentre – metacentric height.	12
II	**FLUID FLOW ANALYSIS** Types of fluid flow – velocity and acceleration of a fluid particle - Rotational – irrotational circulation and vorticity - Flow pattern – stream line – equipotential line – stream tube path line – streak line – flow net – velocity potential – stream function. Principles of conservation of mass – energy – momentum – continuity equation in Cartesian co-ordinates - Euler's equation of motion.	12
III	**FLOW MEASUREMENT** Bernoulli's equation – applications - Venturimeter – orifice meter – nozzle meter - rotameter – elbow meter - pitot tube – Orifice – sharp edged orifice discharging free – submerged orifice – mouth piece - Flow through orifice under variable head – time of emptying a tank with and without inflow. Flow through pipes – laminar and turbulent flow in pipes - Reynold's experiment - Darcy – Weisbach equation for friction head loss – Chezy's formula – Manning's formula – Hazen-William's formula - Major and minor losses in pipes – hydraulic gradient line – energy gradient line. Siphon – water hammer in pipes – gradual and sudden closure of valves	12
IV	**OPEN CHANNEL FLOW** Types of flow in channel – uniform flow – most economical section of channel – rectangular – trapezoidal. Specific energy and critical depth - momentum in open channel flow – specific force – critical flow – computation. Flow measurement in channels – notches – rectangular, Cipolletti and triangular – float method - Flow measurement in rivers/ streams/ canals – weirs – free and submerged flow – current meter – Parshall flume.	12
V	**DIMENSIONAL ANALYSIS AND PUMPS** Dimensional analysis – Fundamental dimensions – dimensional homogeneity – Rayleigh's method and Buckingham Pi-Theorem - concept of geometric, kinematic and dynamic similarity. Important non dimensional numbers – Reynolds, Froude, Euler, Mach and Weber - Pump terminology – suction lift, suction head, delivery head, discharge, water horse power – selection of pump capacity. Centrifugal pumps – components – working – types of pumps and impellers - Priming – cavitation – specific speed – characteristic curves - submersible pumps - Jet pump – jet assembly - Other pumps – Air lift pump - reciprocating pump - sludge pump and vacuum pump- Hydraulic ram.	12
	Total Instructional Hours	**60**

COURSE   Upon successful completion of the course, students shall have ability to

OUTCOMES   CO1: Comprehend the properties of fluids
            CO2: Understand the various types of fluid flow
            CO3: Calculate the discharge and compute energy losses in pipe flow
            CO4: Classify open channel flows and also design the most economical sections for open channel flows
            CO5: Select appropriate model to provide solution to a real time problem related to hydraulics and also assess the performance of pumps

TEXT BOOKS:

T1   Streeter V.L., Wylie E. B. and Bedford K. W., "Fluid Mechanics", Tata McGraw Hill Publishing Co. Ltd., 2017.

T2   Modi P. N. and Seth S M., "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House, New Delhi, 2013

T3   Bansal R.K., "Fluid Mechanics & Hydraulic Machines", Laxmi Publications, 2015.

REFERENCE BOOKS:

R1   Garde, R. J., "Fluid Mechanics through problems", New Age International Publishers (P) Ltd., New Delhi, 2002.

R2   Kumar .K.L, "Engineering Fluid Mechanics", Eurasia Publishing House, 2002.

R3   Jagdish Lal, "Hydraulic Machines". Metropolitan Book House, New Delhi, 2000.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG3203	PRINCIPLES AND PRACTICES OF CROP PRODUCTION	3	0	0	3

Course Objective	• To introduce the students to principles of agricultural and horticultural crop production and to introduce the production practices of crops. • To delineate the role of agricultural and irrigation engineers in relation to various crop production practices.

Unit	Description	Instructional Hours
I	**AGRICULTURE AND CROP PRODUCTION** Introduction to agriculture and its crop production sub-sectors - field crop production and horticulture; Factors affecting crop growth and production: genetic (internal) and environmental (external) factors; Crop management through environmental modification and adaptation of crops to the existing environment through crop cultural practices	9
II	**CROP SELECTION AND ESTABLISHMENT** Regional and seasonal selection of crops; Systems of crop production; Competition among crop plants; Spacing and arrangement of crop plants; Field preparation for crops including systems of tillage; Establishment of an adequate crop stand and ground cover, including selection and treatment of seed, and nursery growing	9
III	**CROP MANAGEMENT** Crop water Management; Crop nutrition management - need for supplementation to soil supplied nutrients, sources, generalized recommendations, methods and timing of application of supplemental nutrients including fertigation scheduling; Crop protection including management of weeds, pests and pathogens; Integrated methods of managing water, nutrients and plant protection; Types and methods of harvest.	9
IV	**PRODUCTION PRACTICES OF AGRICULTURAL CROPS** Generalized management and cultivation practices for important groups of field crops in Tamil Nadu: cereal crops, grain legumes, oil seed crops, sugarcane, and fiber crops, and special purpose crops such as those grown for green manure and fodder.	9
V	**PRODUCTION PRACTICES OF HORTICULTURAL CROPS** Important groups of horticultural crops in Tamil Nadu such as vegetable crops, fruit crops, flower crops; Cultivation practices of representatives of each group; Special features of production of horticultural crops - green house cultivation.	9
	Total Instructional Hours	45

COURSE OUTCOMES	Upon successful completion of the course, students shall have ability to CO1: Students completing this course would have acquired knowledge on crop selection, crop production crop management. CO2: The students will have the required knowledge in the area of production of agricultural and horticultural crops CO3: Understanding the important of Crop water Management and Crop nutrition management in crop cultivation. CO4: Understanding the field crop production practices in Tamil Nadu. CO5: Understand the role of greenhouse cultivation in future.

TEXT BOOKS:

T1   S S Rajendra Prasad, Text Book of Field Crop Production. Directorate of Information and Publication, Krishi Anusandhan Bhavan, Pusa, New Delhi, 2015.

T2   Reddy T. Sankara G.H. Yellamanda Reddi, Principles of Agronomy, Kalyani Publishers, New Delhi, 2005.

T3   Handbook of Agriculture. ICAR Publications, New Delhi, 2011

REFERENCE BOOKS:

R1   Bose T. K. and L.P.Yadav. Commercial Flowers, Naya Prakash, Calcutta.1989.

R2   Crop Production Guide, Tamil Nadu Agricultural University Publication, Coimbatore. 2005

R3   Kumar, N., Abdul Khader, M. Rangaswami, P. and Irulappan. I. Introduction to spices, plantation crops, medicinal and aromatic plants. Rajalakshmi Publications, Nagercoil. 1993.

R4   Kumar, N.,"Introduction to Horticulture", Rajalakshmi Publications. Nagercoil, 7th edition, 2015.

R5   Shanmugavel, K.G. Production Technology of Vegetable Crops. Oxford India Publications, New Delhi. 1989

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG3251	UNIT OPERATIONS IN AGRICULTURAL PROCESSING	2	0	2	3

Course Objective	The students would be exposed to the fundamental knowledge in Evaporation, Filtration, Sedimentation, Processing, Sieve analysis, Crystallization and Distillation in processing of agricultural produce.

Unit	Description	Instructional Hours
I	**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-performance of evaporators and boiling point elevation – capacity – economy and heat balance- types of evaporators – once through and circulation evaporators – short tube evaporators and long tube evaporators – agitated film evaporator	9
II	**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.	9
III	**SIZE REDUCTION** 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 equipments – crushers – jaw crusher, gyratory crusher-crushing rolls – grinders – hammer mills – rolling compression mills - attrition, rod, ball and tube mills – construction and operation.	9
IV	**CONTACTEQUILIBRIUM 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 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	9
V	**CRYSTALLISATION AND DISTILLATION** Crystallization-Equilibrium –Rate of crystal growth stage-Equilibrium crystallization-Crystallizers-Equipment-Classification- Construction and operation – Crystallizers-Tank-Agitated batch-Swenson-Walker and Vacuum crystallizers-Distillation-Binary mixtures-Flash and differential distillation-Steam distillation –Theory-Continuous distillation with rectification –Vacuum distillation - Batch distillation-Operation and process-Advantages and limitation-Distillation equipments- Construction and operation-Factors influencing the operation.	9

Total Instructional Hours	**45**

COURSE OUTCOMES	At the end of the study the student will have knowledge on
	CO1:Fundamentals of various unit operations of Agricultural Processing.
	CO2: Understand the liquid characteristics and performance of single and multiple effect evaporation
	CO3: Classify the filter media types and its requirements and sedimentation of particles in a fluid.
	CO4: Size reduction equipment and calculating the power requirements
	CO5: Understand the equilibrium separation processes and importance of crystallisation and distillation in agricultural processing.

TEXT BOOKS:

T1   Earle, R.L., "Unit operations in Food Processing", Pergamon Press, Oxford, U.K, 1985.

T2   McCabe, W.L., and Smith, J.C., "Unit Operations of Chemical Engineering", Mc-Graw-Hill Inc., Kosaido Printing Ltd., Tokyo, 1990.

T3   Geankoplis, C.J. "Transport Processes and Separation Process Principles", 4th Edition, Prentice Hall, 2003.

REFERENCE BOOKS:

R1   Coulson, J.M and J.F. Richardson. Chemical Engineering. Volume I to V. The Pergamon Press. New York, 1999..

R2   Albert Ibarz and Gustavo V. Barbosa-Cánovas. Unit Operations in Food Engineering. CRC Press LLC, Florida, 2003..

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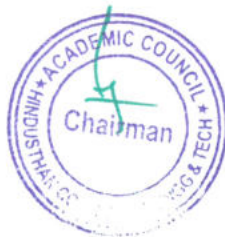
Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG3001	FIELD CROP PRODUCTION PRACTICAL	0	0	3	1.5

Course Objective	
	• To study about field crops and cultivation aspects.
	• To learn the management of crops including soil management and to control the diseases to increase the food production
	• To acquire the knowledge on the nursery production of herbaceous and woody plants for landscape design and management.

Ex. No.	List of Experiments	Instructional Hours
1.	Identification of different crops, seeds, manures and fertilizers	3
2.	Practicing cultivation of rice / maize / pulse crops to raise in new Agri. field area from seed to harvest	3
3.	Identification of farm tools and implements, primary and secondary tillage	3
4.	Practicing different methods of sowing and planting	3
5.	Irrigation, fertilizer application and weed management practices	3
6.	Biometric Observation of field crops	3
7.	Working out Problems on seed rate, Fertilizer dose, Yield estimation	3
8.	Assessing maturity indices for harvesting of agricultural crops	3
9.	Workout the cost of cultivation of major field crops.	3
10	Harvesting and post – harvest technology in field crops.	3
	Total instructional hours	**30**

COURSE OUTCOMES

At the end of the study the student will have knowledge on
CO1: Possess the knowledge on the agronomic practices for raising different crops and intensive cultivation through use of improved varieties and the liberal use of irrigation and fertilizers to increase the food production.
CO2: Utilize the knowledge on rainfed and dry land agriculture and precision farming.
CO3: Possess the knowledge on the commercial production of high-value horticultural crops such as fruits, vegetables, cut flowers, potted plants, bedding plants, and bulbs and floral design.
CO4: Possess the knowledge on harvesting methods, pre cooling, packaging and storage of horticultural crops.
CO5: To calculate cost of cultivation for various field crop

REFERENCE BOOKS:

R1   SP. Palaniappan, and S. Sivaraman, Cropping systems in the tropics- Principles and Management, New Age international publishers, New Delhi, (2nd edition), 1998.

R2   S.Sankaran and V.T Subbaiah Mudaliar, Principles of Agronomy, The Bangalore Printing and Pub. Co., Bangalore, 1993.

R3   P.Balasubramain and SP. Palniappan, Principles and Practices of Agronomy, Agrobios publishers, Ludhiana. 2001.

R4   T.Yellamanda Reddy and G.H. Sankara Reddi, Principles of Agronomy, Kalyani publishers, Ludhiana, 2005

R5   B.Chandrasekaran, B., K. Annadurai and E. Somasundaram, A Text book of Agronomy, Scientific publishers, Jodhpur, 2007.

R6   George Acquaah, Horticulture-principles and practices, Prentice-Half of India Pvt. Ltd., New Delhi, 2002.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG3002	SOIL SCIENCE LABORATORY	0	0	3	1.5

Course Objective	Students should be able to verify various quality aspects of soil and water studied in theory by performing experiments in lab

Ex. No.	List of Experiments	Total Instructional Hours
1.	Identification of rocks and minerals	
2.	Collection and processing of soil samples	
3.	Determination of soil moisture, EC and pH	
4.	Field density determination by Core Cutter and Sand Replacement method	
5.	Specific gravity determination by Pycnometer	
6.	Textural analysis of soil by International Pipette method	
7.	Grain size analysis by using Mechanical shaker	
8.	Determination of Organic carbon	
9.	Estimation of Gypsum requirements	
10	Specific gravity determination by Pycnometer	
	Total instructional hours	**30**

Course Outcome	The students completing the course will have CO1: Students will be able to describe the various mineral and organic components of soils, including how changes in various quantities affect soil physical and chemical properties CO2: Students will understand pedogenesis and how different parent materials create soils with varying properties. CO3: Students will understand water retention and movement in soils, especially as it relates to plant water availability CO4: Students will develop a basic understanding of soil chemistry, including pH and CEC, especially how they relate to nutrient availability and, when feasible, adjustments, such as liming, that can improve conditions for plant growth. CO5: Students will develop an introductory understanding of soil taxonomy, including the favorable traits and limitations of the various soil orders.

REFERENCE BOOKS:

R1   Punmia, B.C, "Soil Mechanics and Foundation Engineering", Laxmi Publishers, New Delhi. 2007

R2   Laboratory Manual, Centre for Water Resources, Anna University, Chennai. 2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MC3191	INDIAN CONSTITUTION	2	0	0	0

Course Objective

1. Sensitization of student towards self, family (relationship), society and nature.
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Unit	Description	Instructional Hours
	BASIC FEATURES AND FUNDAMENTAL PRINCIPLES	
I	Meaning of the constitution law and constitutionalism – Historical perspective of the constitution of India – salient features and characteristics of the constitution of India.	4
	FUNDAMENTAL RIGHTS	
II	Scheme of the fundamental rights – fundamental duties and its legislative status – The directive principles of state policy – its importance and implementation - Federal structure and distribution of legislative and financial powers between the union and states.	4
	PARLIAMENTARY FORM OF GOVERNMENT	
III	The constitution powers and the status of the president in India. – Amendment of the constitutional powers and procedures – The historical perspective of the constitutional amendment of India – Emergency provisions National emergency, President rule, Financial emergency.	4
	LOCAL GOVERNANCE	
IV	Local self-government -constitutional scheme of India – Scheme of fundamental right to equality – scheme of fundamental right to certain freedom under article21 – scope of the right to life and personal liberty under article 21.	4
	INDIAN SOCIETY	
V	Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	4
	Total Instructional Hours	20

Course Outcome

CO1: Understand the functions of the Indian government
CO2: Understand and abide the rules of the Indian constitution.

TEXT BOOKS:

T1- Durga Das Basu, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi, 2197.
T2- R.C.Agarwal, "Indian Political System", S.Chand and Company, New Delhi.2197.
T3-Maciver and Page, " Society: An Introduction Analysis", Laxmi Publications,2007.
T4-K.L.Sharma, "Social Stratification in India: Issues and Themes",SAGE Publications Pvt. Ltd, 2197.

REFERENCE BOOKS:

R1-Sharma, Brij Kishore, " Introduction to the Constitution of India", Prentice Hall of India, New Delhi,2017.
R2-U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar,2198.
R3-R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.2182.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG4201	FARM TRACTORS	3	0	0	3

Course Objective

1. To introduce the students about basics of tractor which include classification of tractors and components of the engine.
2. To retrieve basic knowledge about engine systems and working principles of cooling system, lubrication system, fuel systems and electrical systems of tractors.
3. To study about working principle of transmission system of tractor and its components.
4. To learn about components of hydraulic system of tractor and its working principle.
5. To acquire knowledge on Power tiller, Bull dozers, testing of tractors, performance of various machines

Unit	Description	Instructional Hours
I	**TRACTORS** 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.	9
II	**ENGINE SYSTEMS** Valves-inlet and outlet valves – valve timing diagram. Air cleaner- exhaust – silencer. Cooling systems - lubricating systems - fuel system – governor- electrical system.	9
III	**TRANSMISSIONSYSTEMS** 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.	9
IV	**HYDRAULIC SYSTEMS** Hydraulic system - working principles, three-point linkage - draft control - weight transfer, theory of traction - tractive efficiency – tractor chassis mechanics - stability - longitudinal and lateral. Controls - visibility – operators' seat.	9
V	**POWER TILLER, BULL-DOZER AND TRACTOR TESTING** Power tiller - special features - clutch - gear box - steering and brake. Makes of tractors, power tillers and bulldozers. Bulldozer- salient features – turning mechanism, track mechanism, components – operations performed by bulldozers. Types of tests- test procedure - need for testing & evaluation of farm tractor -Test code for performance testing of tractors and power tillers.	9
	Total Instructional Hours	45

Course Outcome

At the end of the study the student will have knowledge on

CO1: The students will be able to understand the various equipment's and mechanizations used in the farm

CO2: The students will have the knowledge on earth moving machineries, tractor classification and tillage implements.

CO3: The students will able to understand various engine systems and its working principle.

CO4: The student will able to understand various implements used in agriculture farm for various purposes

CO5: The students will get basic idea about testing procedures of various farm machinery equipment's.

TEXT BOOKS:

T1   Jain, S.C. and C.R. Rai. "Farm tractor maintenance and repair". Standard publishers and distributors, New Delhi, 1999

REFERENCE BOOKS

R1   Barger, E.L., J.B. Liljedahl and E.C. McKibben, "Tractors and their Power Units". Wiley Eastern Pvt. Ltd., New Delhi,1997

R2   Domkundwar A.V. "A course in internal combustion engines". Dhanpat Rai & Co. (P) Ltd., Educational and Technical Publishers, Delhi,1999

R3   Black, P.O. "Diesel engine manual". Taraporevala Sons& Co., Mumbai,1996.

R4   Grouse, W.H. and Anglin, D.L. "Automative mechanics". Macmillan McGraw- Hill, Singapore, Indian Standard Codes for Agricultural Implements Published by ISI, New Delhi,1993.

R5   Jagadeeshwar Sahay, "Elements of Agricultural Engineering", Standard Publishers Co., New Delhi, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG4202	THERMODYNAMICS	3	0	0	3

Course Objective	• To make the students understand the basic laws of thermodynamics and heat transfer as applied in the different branches of Agricultural Engineering.
	• To impart a good exposure on the principles of operation of thermal equipments like IC engine, boilers, turbine and refrigerator etc. applied to Agricultural Engineering Machinery and Process designs.

Unit	Description	Instructional Hours
I	**BASIC CONCEPTS OF THERMODYNAMICS** Thermodynamics and Energy – Systems – Types and properties - State and Equilibrium - Processes and Cycles – Forms of Energy – Temperature and Zeroth law of Thermodynamics – Pure substances – Phase change processes of pure substances – Property diagrams – Internal energy – Enthalpy – Energy transfer by Heat, Work and Mass – Applications.	9
II	**FIRST AND SECOND LAW OF THERMODYNAMICS** First law of thermodynamics – Energy balance for closed systems and steady flow systems – Applications of First law of Thermodynamics – Energy balance for Unsteady flow processes – Second law of Thermodynamics – Entropy – Carnot principles – Change in Entropy – Entropy and irreversibility -Applications.	9
III	**HEAT ENGINES** Internal Combustion Engines – C.I and S.I Engines – Four Stroke and Two Stroke Engines – Gas Turbines - Boilers – Fire Tube Boiler & Water Tube Boilers , Boiler Accessories and Components. Turbines – Impulse Turbine and Reaction Turbine , Turbine Components - Refrigeration Cycle – Vapour Compression & Vapour Absorption System ,Gas Refrigeration System – Environmental friendly Refrigerants – Air Conditioning.	9
IV	**GASES AND VAPOUR MIXTURES** Ideal and Real gases – Vander waals equations – Reduced property – Compressibility chart -Properties of mixture of gases – Dalton"s law and Gibbs – Dalton law – Internal energy, Enthalpy and specific heats of gas mixtures.	9
V	**HEAT TRANSFER** Conduction – Plane Wall, Cylinder system, Composite Walls – Critical insulation thickness – Simple, fins convection – Free convection and forced convection – Flow over Flat plates and Flow through Pipes – Radiation – Black Body, Grey Body Radiation.	9

Total Instructional Hours   45

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Course Outcome	CO1: Classify mechanisms and inversions and determine mobility of a mechanism.
	CO2: Construct cam profiles for various followers and turning moment diagram for flywheel.
	CO3: Classify various gear trains and apply to automation.
	CO4: Apply friction principles to clutches, belt, brake and screw.
	CO5: Evaluate the sensitivity of governor

TEXT BOOKS:

T1 Yunus A. Cenegal and Michael A.Boles, "Thermodynamics: An Engineering Approach", Fourth Edition, Tata McGraw-hill, 2004.

T2 Michael J.Moran, Howard N.Shapiro, "Fundamentals of Engineering Thermodynamics", Fourth Editon, John wiley &Sons, 2000.

REFERENCE BOOKS:

R1 R.K.Rajput, "A Text book of Engineering Thermodynamics", Third Edition, Laxmi publication (P) Ltd., 2007.

R2 Nag.P.K., "Engineering Thermodynamics", Third Edition, Tata McGraw hill, 2005.

R3 Domkundwar.S., C.P.Kothandaraman "A Course in Thermal Engineering", Fifth Edition, Dhanpat Rai & Co (p) Ltd, 2000.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG4203	IRRIGATION AND DRAINAGE ENGINEERING	3	0	0	3

Course Objective	• At the completion of the course the students should be able to understand the necessity of planning an irrigation system to provide water at the right time and right place. • To understand the basic concepts for planning, design and management of land drainage works in cultivated areas

Unit	Description	Instructional Hours
I	**WATER RESOURCES AND IRRIGATION REQUIREMENT** Water Resources- River basins-Development and Utilization in India and Tamil Nadu-Irrigation – duty and delta - Rooting characteristics - Moisture use of crop, Evapotranspiration - ET plot – Crop water requirement - Effective rainfall - Scheduling - Irrigation requirement - Irrigation frequency, Irrigation efficiencies.	9
II	**METHODS OF IRRIGATION** Methods of Irrigation – Surface and Subsurface methods – Drip and Sprinkler - Hydraulics and design - Erodible and non-erodible, Kennedy"s and Lacey"s theories, Materials for lining water courses and field channel, Water control and diversion structure - Underground pipeline irrigation system	9
III	**DIVERSION AND IMPOUNDING STRUCTURES** Head works –Weirs and Barrage –Types of impounding structures - Factors affecting, location of dams -Forces on a dam -Design of Gravity dams- Earth dams, Arch dams – Spillways -Energy dissipaters.	9
IV	**CANAL IRRIGATION AND COMMAND AREA DEVELOPMENT** Classification of canals- Alignment of canals – Design of irrigation canals– Regime theories - Canal Head works – Canal regulators - Canal drops – Cross drainage works – Canal Outlet, Escapes – Lining and maintenance of canals - Excess irrigation and waterlogging problem - Command area - Concept, Components of CADP - On Farm Development works, Farmer"s committee - its role for water distribution and system operation - rotational irrigation system	9
V	**AGRICULTURAL DRAINAGE** Agricultural drainage - Drainage coefficient; principles of flow through soils, Darcy"s law – infiltration theory, Surface drainage systems - Subsurface drainage - Design of subsurface drainage - Pipe materials - mole drains, drainage wells, Leaching requirements - irrigation and drainage water quality - recycling of drainage water for irrigation.	9
	Total Instructional Hours	45

Course Outcome	The students completing the course will have CO1: The students will have knowledge and skills on Planning, design, operation and management of reservoir system. CO2: The student will gain knowledge on different methods of irrigation CO3: The student will able to understand various diversion and impounding structures. CO4: The student will grab knowledge about the command area development and canal irrigation system.

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CO5: The students will retrieve basic idea about reclamation of the soils under water logged conditions and salinity problems.

TEXT BOOKS:

T1   Dilip Kumar Majumdar., "Irrigation Water Management", Prentice-Hall of India, New Delhi, 2008.

T2   Michael, A.M., "Irrigation Engineering", Vikas Publishers, New Delhi,2008

T3   Garg, S.K., "Irrigation Engineering," Laxmi Publications, New Delhi,2008

T4   Ritzema, H.P., "Drainage Principles and Applications", Publication No. 16, International Institute of Land Reclamation and Improvement, Netherlands,1994.

REFERENCE BOOKS

R1   Basak, N.N., "Irrigation Engineering", Tata McGraw-Hill Publishing Co, New Delhi,2008.

R2   Murthy, V.V.N. "Land and water management", Kalyani publishing, New Delhi,1998.

R3   Bhattacharya, A.K., and Michael, A.M., "Land Drainage – Principles, Methods and Applications", Konark Publishers Pvt. Ltd., New Delhi, 2003.

R4   "Irrigation water Management", Training Manual No 6, Drainage of Irrigated Lands, Food and Agriculture Organisation, Rome1996

R6   Kessler, J., "Drainage Principles and Applications", Vol. II and IV, International Institute of Land Reclamation and Improvement, Netherlands,1979

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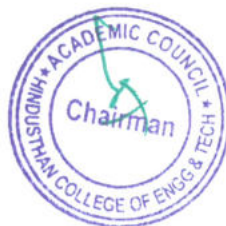
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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA4152	STATISTICS & NUMERICAL METHODS (AGRI, BIO MEDICAL & FOOD TECHNOLOGY)	3	0	2	4

Course Objective	• Introduce Correlation concept to identify the linear relationship between two variables. • Provide the necessary basic concepts of some statistical methods. • Manipulate different kinds of problems occurring in engineering and technology by applying the • design of experiments. • Apply various methods to find the intermediate values for the given data. • 5. Be Familiar with the concepts of numerical differentiation and numerical integration of the Unknown functions.

Unit	Description	Instructional Hours
I	**CORRELATION AND REGRESSION** Correlation – Karl Pearson's correlation coefficient – Spearman's Rank Correlation – Regression lines(problems based on Raw data only).	9
II	**HYPOTHESIS TESTING** Tests based on t (for single mean and difference of means) - F distribution – for testing difference of variance, Chi – Square test for Contingency table (Test for Independency) – Goodness of fit	9
III	**ANALYSIS OF VARIANCE** Introduction, analysis of variance, completely randomized design, randomized block design, Latin square design.	9
IV	**INTERPOLATION** Interpolation: Newton's forward and backward difference formulae Lagrangian interpolation for unequal intervals – Divided differences- Newton's divided difference formula.	9
V	**NUMERICAL DIFFERENTIATION AND INTEGRATION** Differentiation using interpolation formula – Newton's forward and backward interpolation formulae for equal intervals – Newton's divided difference formula for unequal intervals - Numerical integration by Trapezoidal and Simpson's 1/3 rules.	9
	Total Instructional Theory Hours	45

LAB COMPONENTS USING R-STUDIO(any 5 experiments)
1. Introduction to R programming
2. Application of descriptive statistics – Mean, Median, Mode, variance and Box plot
3. Applications of Correlation and Regression
4. Application of Student t- test
5. Application of F test
6. Application of Chi – square test
7. ANOVA – completely randomized design
8. ANOVA – randomized block design

Instructional Hours - Lab	15
Total Instructional Hours	**60 Hours**

	At the end of the study the student will have knowledge on
COURSE OUTCOMES	CO1: Compute correlation between variables, and predict unknown values using regression. CO2: Acquire skills in analyzing statistical methods. CO3: Have a clear perception of the statistical ideas and demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields. CO4: Understand the concept of interpolation in both cases of equal and unequal intervals. CO5: Express the information from discrete data set through numerical differentiation and summary information through numerical integration.

TEXT BOOKS:

T1   Gupta, S.C., & Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Reprint 2011.

T2   M.K.Jain,S.R.K.Iyengar, R.K.Jain "Numerical methods for Scientific and Computation", Fifth Edition, New Age International publishers 2010

REFERENCE BOOKS:

R1   Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers

    and Scientists", 8th Edition, Pearson Education, Asia, 2007.

R2   Grewal B.S. and Grewal J.S. "Numerical Methods in Engineering and Science ", 6th Edition , Khanna publishers, New Delhi 2004.

R3   S.K.Gupta, Numerical Methods for Engineers" , New Age Internationalm Pvt.Ltd Publishers,2015

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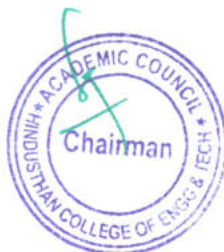
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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG4251	BIO - ENERGY RESOURCE TECHNOLOGY	2	0	2	3

Course Objective	• To impart the fundamental knowledge on the importance of Bio resources, Bio energy and reactors. • Alcohol and ethanol production and Energy and Environment

Unit	Description	Instructional Hours
I	**BIO RESOURCE - AN INTRODUCTION`** Bio resource – origin – biomass types and characteristics- biomass conversion technology- Biodegradation - steps in biogas production- parameters affecting gas production- Types of biogasplants- Construction details- operation and maintenance	9
II	**BIO ENERGY** Slurry handling- enrichment and utilization – Biogas appliances- Biochemical characteristics of bio resources- Bioenergetics –Biocatalysis –Kinetics of product formation.	9
III	**BIO REACTORS AND FERMENTORS** Bio reactors/ fermentors – Batch type – continuous stirred tank reactors- Biological waste water treatment- Activated sludge process- Downstream Processing-Recovery and purification of products.	9
IV	**ALCOHOL PRODUCTION** Alcohol ethanol production - Acid hydrolysis - enzyme hydrolysis-Methanol synthesis - Antibioticsenzymes- principles of thermochemical conversion – combustion - pyrolysis- Gasification – types of gasifiers.	9
V	**ENERGY AND ENVIRONMENT** Principles of operation- chemical reaction- cleaning and cooling - Utilization- Improved wood burning stove - Energy plantations- Biomass briquetting - co generation- Impact on Environment — Bioenergy policy	9
	Total Instructional Hours	45

Course Outcome	CO1: The students will be able to understand the concepts of bio energy sources and its applications.
	CO2: Possess the knowledge on biochemical conversion technology and biofuels
	CO3: Possess the knowledge on reactors
	CO4: Possess the knowledge on thermal conversion technologies
	CO5: Students understand the concepts of chemical reaction

TEXT BOOKS:

T1   Rai G.D, "Non-conventional sources of Energy", Khanna publishers, New Delhi, 1995.

T2   Bouley James. E & David Follis, "Biochemical Engineering Fundamentals", Mc Graw-Hill publishing company, Tokyo.1986

REFERENCE BOOKS:

R1   Chawla O.P, "Advances in Biogas Technology", ICAR publication New Delhi 1986

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG4252	SURVEYING AND LEVELING	2	0	2	3

Course Objective	1. To gain knowledge on basic principle and concepts of different surveying methods.
	2. To learn how to use compass to carryout land surveying.
	3. To learn the basics of leveling and its applications.
	4. To explore the types and characteristics of contours.
	5. To understand the concepts of Theodolite survey in linear and angular measurements.

Unit	Description	Instructional Hours
I	**FUNDAMENTALS AND CHAIN SURVEYING** Definition- Classifications - Basic principles – Equipment and accessories for ranging and chaining – Methods of ranging - well conditioned triangles - computation of cross sectional areas (Simpon's rule and Trapezoidal rule) **Aligning, Ranging and Chaining** **Computation of area of the plot using Chain traversing**	9
II	**COMPASS AND PLANE TABLE SURVEYING** Compass – Basic principles - Types - Bearing systems and conversions – Sources of Errors - Local attraction - applications - Plane table and its accessories - Merits and demerits. Computation of included angle between stations using Compass Traversing Plane table Surveying - Radiation Method Plane table Surveying – Intersection Method	9
III	**LEVELLING** Levelling- Principles and theory of Levelling - Datum - Bench Marks – Temporary and Permanent Adjustments- Methods of Levelling - Sources of errors in Levelling Fly levelling using Dumpy Level (Height of Instrument and Rise & Fall method)	9
IV	**CONTOURING** Contouring - Methods – Characteristics and uses of contours - Plotting – Methods of interpolating contours – Earthwork calculations - Capacity of reservoirs - Mass haul diagrams. Grid Contouring.	9
V	**THEODOLITE AND MODERN SURVEYING** Theodolite – components of theodolite - Temporary and permanent adjustments - Heights and distances by single plane and double method. **Computation of area by Theodolite Traverse** **Introduction to Total Station- Global Positioning System (GPS)**	9

	Total Instructional Hours	45

COURSE OUTCOMES	At the end of the study the student will have knowledge on
	CO1: Carryout preliminary surveying to prepare a layout of a given area.
	CO2: Apply compass surveying and plane table surveying.
	CO3: Understand the basics of leveling and measure the elevations.
	CO4: Plot contours and also calculate the capacity of reservoirs.
	CO5: To carry out linear and angular measurements using theodolite

TEXT BOOKS:

T1   Punmia, B. C., "Surveying", Vol.1, Laxmi Publications, New Delhi. 2015.

T2   Chandra A.M., "Plane Surveying", New Age International Publishers, 2015

REFERENCE BOOKS:

R1   Alak De, "Plane Surveying", S. Chand & Company Ltd., 2000.

R2   Bannister and S. Raymond, R. Baker "Surveying", 7th Edition, Pearson Education Ltd., 2009.

R3   Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice Hall of India, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19AG4001	IRRIGATION FIELD LAB	0	0	4	2

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

Ex. No.	List of Experiments	Total Instructional Hours
1.	To study various instruments in the Meteorological Laboratory	4
2.	Determination of infiltration rate using double ring and digital infiltrometer	4
3.	Determination of soil moisture wetting pattern for irrigation scheduling	4
4.	Design of Drip irrigation system	4
5.	Design of sprinkler irrigation system	4
6.	Measurement of flow properties in open irrigated channels (flumes, notches)	4
7.	Evaluation of surface irrigation	4
8.	Determination of uniformity coefficient for drip irrigation system	4
9.	Determination of uniformity coefficient for sprinkler system (catch can method)	4
10	To conduct experiment on disc filter for micro irrigation systems	4
	Total instructional hours	**48**

S.NO	LIST OF EQUIPMENTS REQUIRED	REQUIRED QUANTITY
1.	Meteorological lab with Cup counter anemometer, Sunshine recorder, Open pan vaporimeter, Stevenson's screen - Dry bulb, wet bulb thermometers, recording and non-recording type rain gauge etc	Each 1
2.	Double ring infiltrometer	1
3.	Digital infiltrometer	1
4.	Parshall flume, cut throat flume	Each 1
5.	V notch, Rectangular notch and trapezoidal notch	Each 1
6.	Drip irrigation system with all accessories	1
7.	Sprinkler irrigation system with all accessories	1
8	Required number of stop watches	3
9	Weight balance	1
10	Catch cans, measuring jars – required numbers	5

Course Outcome	The students completing the course can CO1: gain the knowledge on various meteorological instruments and understanding the concept of different irrigational systems in the laboratory tests. CO2: understand concept of different methods for estimation of evapotranspiration

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CO3: understand about irrigation management
CO4:design various irrigation system
CO5: able to schedule irrigation system

REFERENCE BOOKS

R1   Michael, A.M., "Irrigation Theory and Practice", Vikas Publishing House, New Delhi,1999.

R2   Asawa, G.L., "Irrigation Engineering", New Age International Private Limited, New Delhi, 1996.

R3   Laboratory Manual, Centre for Water Resources, Anna University, Chennai.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MC4191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2	0	0	0

Course Objective

1. The course aims at imparting basic principles of thought process, reasoning and inferencing.
2. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
3. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
4. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view, basic principles of Yoga and holistic health care system, Indian philosophical traditions, Indian linguistic tradition and Indian artistic tradition.

Unit	Description	Instructional Hours
I	Basic Structure of Indian Knowledge System	4
II	Modern Science and Indian Knowledge System	4
III	Yoga and Holistic Health care	4
IV	Philosophical tradition	4
V	Indian linguistic tradition (Phonology, Morphology, Syntax and semantics),Indian artistic tradition and Case Studies.	4
	Total Instructional Hours	**20**

Course Outcome

CO1: Ability to understand the structure of Indian system of life.
CO2: Connect up and explain basics of Indian Traditional knowledge in modern scientific perspective.

REFERENCE BOOKS:

R1 -V.Sivaramakrishna (Ed.), "Cultural Heritage of India-Course Material", Bharatiya Vidya Bhavan,Mumbai, 5th Edition, 2014.
R2 - Swami Jitatmananda, "Modern physics and Vedanta", Bharatiya Vidya Bhavan,2186.
R3 - Fritjof Capra, The Tao of Physics
R4- Fritjof Capra, The wave of Life.
R5- V N Jha, Tarkasangraha of Annambhatta, Inernational Chinmaya Foundation, Velliyanad,Ernakulam.
R6- Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta.
R7- GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016.
R8- RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi,2016.
R9- P R Sharma (English translation), Shodashang Hridayam.

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG5201	REFRIGERATION AND COLD CHAIN MANAGEMENT	3	0	0	3

Course Objective

1. To understand the principles of unit operations involved in different Refrigeration and cold storage systems and its components.
2. To impart the concept of the basic principles, working, scientific analysis and system components of different types of refrigeration and air conditioning systems
3. To impart basic knowledge on design and maintenance aspects related to cold storage systems.
4. To impart the knowledge of various types of refrigerants, their properties, selection criteria and environmental aspects.
5. To acquire the basic knowledge about various aspects of cold chain management.

Unit	Description	Instructional Hours
I	**REFRIGERATION PRINCIPLES** Refrigeration – principles - refrigeration effect – coefficient of performance – units of refrigeration - simple vapour compression cycle – T-S diagram – P-H chart - application of refrigeration	6
II	**VAPOUR COMPRESSION REFRIGERATION AND COMPONENTS** Vapour compression system - refrigeration components – compressor and condenser – types, construction and working - expansion device and evaporators – types, construction and working	6
III	**REFRIGERANTS AND VAPOUR ABSORPTION CYCLE** Refrigerants – properties – classification – comparison and advantages – chloroflouro carbon (CFC) refrigerants - effect on environmental pollution - alternate refrigerants - vapour absorption cycle – theoretical - deviation in practice - Electrolux refrigerator – construction and principles.	9
IV	**SHELF – LIFE OF FOOD PRODUCTS** Defining overall Shelf-life, remaining shelf life in the context of Chilled & Frozen foods; - Deterioration modes of food items; Models of quality deteriroration- Kinetic model; shelf-life model; Q10/q10 model; TTT model for the remaining shelf – life; General procedure for shelf – life testing – the 11 steps procedure. Storage of frozen foods; - Basic design requirements of storage to uphold the shelf –life – size , insulation, entry –exit position, palletization, proper disk-space for air-circulation, automatic door – closing, proper lighting, temperature monitoring and recording facility; stacking systems, emergency exits, material handling devices like fork-lifts, pallet trucks, etc floor heaters, vapour barriers, etc.	12

COLD CHAIN MANAGEMENT

V | The premises of cold chain - Need for the chain for chilled / frozen food item, various links of the chain; importance of shelf- life; just – in-time deliveries; Temperature limits;- in various countries-Europe, US, Australia etc; Chilling and freezing;- Chilling injury, cook-chilling systems; cold – shortening; PPP and TTT concepts; Temperature monitoring; -Critical temperatures; Temperature –time indicators(TTI); Time – temperature –correlation-the kinetic approach, effective temperature; Transportation regulations; Role of packaging in cold chain– MAS, MAP, CAS, CAP etc; Thaw indicators. | 12

Total Instructional Hours | **45**

Course Outcome

CO1: Introduction of basic principle of different refrigerating systems

CO2: Students will able to understand the effect of different components on the refrigerating machines.

CO3: Upon completion of this course, the students will be able to demonstrate the operations in different Refrigeration & cold storage systems

CO4: They will also able to design Refrigeration & Cold storage systems to increase the shelf life of different agricultural commodities.

CO5: Students will able to understand various aspects of cold chain management and able to rectify chilling injuries.

TEXT BOOKS

T1 Anand, M.L. "Refrigeration& Air-Conditioning". Asian Books Pvt., Ltd., 2002.
T2 Sun, Da-Wen. "Advances in Food Refrigeration". Leatherhead Publishing, 2001.
T3 Kennedy, Christopher J. "Managing Frozen Foods". CRC / Woodhead Publishing, 2000.
T4 Ballney P. L. 1994. Thermal Engineering. Khanna Publishers, New Delhi.
T5 Khurmi R S. 1992. Engineering Thermodynamics. S Chand and Co. Ltd., Ram Nagar, New Delhi.

REFERENCE BOOKS

R1 Evans, Judith. "Frozen Food Science and Technology". Wiley-Blackwell, 2008.
R2 Hui, Y.H. etal., "Handbook of Frozen Foods". Marcel Dekker, 2004.
R3 James, S.J. and C. James. "Meat Refrigeration". CRC / Woodhead Publishing, 2002.
R4 Stringer, Mike and C. Dennis. "Chilled Foods: A Comprehensive Guide". 2nd Edition, CRC / Woodhead Publishing, 2002.
R5 Nag P K.1995. Engineering Thermodynamics. Tata McGraw Hill Publishing Co.Ltd., 12/4 Asaf Ali Raod, New Delhi.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG5202	FARM MACHINERY AND EQUIPMENT	3	0	0	3

Course Objective	1. To introduce the students to the working principles of farm Machinery tillage implements.
	2. To get thorough knowledge about the feasibility of primary and secondary tillage implements.
	3. To gain knowledge about the sowing and fertilizer application methodologies
	4. To acquire basic knowledge in the field of Weeding and Harvesting.
	5. To expose the students to farm mechanization prospects and constraints alongside Cooperative Farming for shared usage of machinery.

Unit	Description	Instructional Hours
I	**FARM MECHANIZATION** Farm mechanization – objectives - Tillage - objectives - methods – primary tillage implements - secondary tillage implements - animal drawn ploughs – construction- Types of farm implements – trailed, mounted. Field capacity - forces acting on tillage tool.	9
II	**PRIMARY AND SECONDARY TILLAGE IMPLEMENTS** Mould board plough- attachments – mould board shapes and types. Disc plough – force representation on disc – Types of disc ploughs – Subsoiler plough - Rotary plough. Cultivators - types - construction. Disc harrows - Bund former - ridger – leveller. Basin lister-Wetland preparation - Puddling and Trampling implements.	9
III	**SOWING AND FERTILIZING EQUIPMENT** Crop planting - methods - row crop planting systems - Devices for metering seeds – furrow openers – furrow closers- types – Types of seed drills and planters – calibration-fertilizer metering devices - seed cum fertilizer drills – paddy transplanters – nursery tray machines.	9
IV	**WEEDING AND PLANT PROTECTION EQUIPMENT** Weeding equipment – hand hoe – long handled weeding tools – dryland star weeder – wetland conoweeder and rotary weeder – Engine operated and tractor weeders Sprayers – types-classification – methods of atomization, spray application rate, droplet size determination – volume median diameter, numerical median diameter – drift control.	9
V	**HARVESTING MACHINERY** Principles of cutting crop, types of harvesting machinery, vertical conveyor reaper, combine harvesters, threshers, tractor on top combine harvester, combine losses.	9
	Total Instructional Hours	45

Course Outcome	CO1: The students will be able to perceive the role and significance of mechanization in sustaining agricultural production
	CO2: The students will get acquainted the contextual usage of various equipment used in the farm for different field operations.
	CO3: The students will able to understand the working principle ofevery equipments used from sowing to harvesting.
	CO4: The students will equip with technical knowledge and skills required for the operation, maintenance and evaluation of Tillage, Sowing and intercultural operational machinery needed for agricultural farms.
	CO5: To develop skills in the students required to develop and modification of indigenous farm machines as per the need of the area and farmers

TEXT BOOKS

T1   Jagdishwar Sahay. Elements of Agricultural Engineering. Standard Publishers Distributors

T2   Jain S. C. and Grace Philip. 2012. Farm Machinery – An Approach. Standard Publishers Distributors., New Delhi

T3   Ojha, T. P. and Michael, A. M. 2011. Principles of Agricultural Engineering Vol. I. Jain Brothers, New Delhi

T4   Yadav, R., and Solanki, H. B. 2009.Numericals and Short Questions in Farm Machinery, Power and Energy in Agriculture.New India Publishing Agency, New Delhi.

T5   Liljedahl, J. B., Turnquist, P. K., Smith, D. W., and Hokey, M. 2004. Tractors and Their Power Units. CBS Publishers and Distributers Pvt. Ltd, New Delhi

REFERENCE BOOKS

R1   Kepner, R.A., et al. Principles of farm machinery. CBS Publishers and Distributers, Delhi. 99, 1997.

R2   Harris Pearson Smith et al. Farm machinery and equipment. Tata McGraw-Hill pub., New Delhi.,1996.

R3   Srivastava, A.C. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi, 1990

R4   Singh, S., and Verma, S. R. 2009.Farm Machinery Maintenance and Management. Indian Council of Agricultural Research, New Delhi

R5   Kirpal Singh. 2013. Automobile Engineering Vol. I. Standard Publishers Distributors, Delhi

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG5203	DESIGN OF FARM IMPLEMENTS AND MACHINERY	3	0	0	3

Course Objective	• To impart the students with a knowledge base on the basic design parameters and principles in agricultural machines
	• To acquaint and equip with the design procedures of farm machinery systems.
	• To design the various components of farm equipments/ implements.
	• To equip the students to draw the farm implements using conventional or advanced drawing tools.
	• To expose the students to the updated trends of machinery design using appropriate software for getting the drawings as guidelines for production.

Unit	Description	Instructional Hours
I	**STRESSES IN MACHINE MEMBERS** Introduction to design parameters of agricultural machines & design procedure - Characteristics of farm machinery design - factor influencing the machine design, selection of material based on mechanical properties- Direct, bending and torsional stress equations- calculation of PRINCIPAL/DEAN ACADEMIC stresses for combined loading. Design of curved beams- factor of safety – theories of failure- stress concentration- design of variable loading- Soderberg and Goodman relations	9
II	**DESIGN OF POWER TRANSMISSION SYSTEMS** Design of standard power transmission components used in agricultural machines: mechanical & hydraulic units - Selection of V-Belts and pulleys- selection of flat belts and pulleys- wire ropes and pulleys- selection of transmission chains and sprockets - Design of pulleys and sprockets- safety in power transmission- Application of design principles to the systems of selected farm machines.	9
III	**DESIGN OF SHAFTS AND COUPLINGS** Design of solid and hollow shafts based on strength and rigidity- Design of keys, keyways and splines- Design of rigid and flexible couplings. Design of bolts and nuts - knuckle and cotter joints - Critical appraisal in production of Agricultural Machinery; Advances in material used for agricultural machinery. Cutting tools including CNC tools and finishing tools. Advanced manufacturing techniques including powder metallurgy, EDM (Electro-Discharge Machining).	9
IV	**DESIGN OF ENERGY STORING ELEMENTS** Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs - Heat Treatment of steels including pack carburizing, shot pining process, etc. Limits, Fits &Tolerances, Jigs & Fixtures.	9

DESIGN OF GEARS AND BEARINGS

V	Gears - spur gear and helical gear - terminology - strength of gear teeth - Lewis equation - Buckingham equation. - Failure of gear teeth. Design of bearings – sliding contact and rolling contact types. – Cubic mean load – Design of journal bearings – Mckees equation – Lubrication in journal bearings – calculation of bearing dimensions.	9

Total Instructional Hours   **45**

Course Outcome	At the end of the course:
	CO1: The student will acquire the knowledge on the basic design principles of agricultural machineries.
	CO2: The students will acquire knowledge on the design procedure of farm machinery systems.
	CO3: The students can design the various components of farm equipments/ implements.
	CO4: The students will be equipped for detailed design and drawing of various components of agricultural machineries
	CO5: The students will be exposed to the latest trends in machinery design using appropriate software.

TEXT BOOKS:

T1. Khurmi R.S and Gupta J.K, "A Textbook of Machine Design", Euarsia publication house, 2005.

T2. Bhandari V.B, "Design of Machine Elements", Tata McGraw-Hill Book Co, 2003.

REFERENCE BOOKS:

R1. Norton R.L, " Machine Design – An Integrated Approach", Pearson Publications, 3rd Edition, 2006.

R2. Srivastava A.K., Goering.C.E. and Rohrbach R.P.,Engineering " Principles of Agricultural Machines", Revised Printing by American Society of Agricultural Engineers. 1993.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG5204	POST HARVEST TECHNOLOGY	3	0	0	3

Course Objective	
	• To expose the students to fundamental knowledge in engineering properties of agricultural materials for different Post Harvest operations.
	• To make students familiar with different aspects of post- harvest technology and recent developments that have taken place in this field.
	• To aware the student with technological changes occurring in this field along with pre and post-harvest operations.
	• To provide more knowledge on various processing methods of harvested crops and storage of produces.
	• To aware the students about different crop processing techniques employed.

Unit	Description	Instructional Hours
I	**BASICS OF POST HARVEST OPERATIONS** Post–harvest technology – introduction –objectives –post harvest losses of cereals, pulses and oilseeds – importance - optimum stage of harvest. Threshing – traditional methods mechanical threshers – types-principles and operation-moisture content –measurement – direct and indirect methods – moisture meters – equilibrium moisture content.	9
II	**PSYCHROMETRY AND DRYING** Psychrometry – importance – Psychrometric charts – Drying – principles and theory of drying – Moisture Content expressions - thin layer and deep bed drying – Hot air drying – methods of producing hot air – Types of grain dryers – selection – construction, operation and maintenance of dryers – Design of dryers	9
III	**CLEANING AND GRADING** Principles of Cleaning - air screen cleaners – adjustments - cylinder separator - spiral separator – magnetic separator - colour sorter - inclined belt separator – length separators - effectiveness of separation and performance index.	9
IV	**SHELLING AND HANDLING** Principles and operation – maize sheller, husker sheller for maize – groundnut decorticator –castor sheller – material handling – belt conveyor –screw conveyor – chain conveyor – bucket elevators – pneumatic conveying.	9
V	**CROP PROCESSING** Paddy processing – parboiling of paddy – methods – merits and demerits dehusking of paddy –methods – merits and demerits – rice polishers –types – constructional details – polishing –layout of modern rice mill - wheat milling – pulse milling methods – oil seed processing – millets processing.	9

	Total Instructional Hours	45

Course Outcomes	CO1: The student will acquire more knowledge on different material handling equipments
	CO2: The students will understand the fundamentals of various unit operations of Agricultural Processing.
	CO3: The students got familiarized with different aspects of post- harvest technology and recent developments that have taken place in this field.
	CO4: The student will be equipped with the technological changes occurring in this field along with pre and post-harvest operations.
	CO5: The students acquire more knowledge on various processing methods of harvested crops and storage of produces and different crop processing techniques employed

TEXT BOOKS:

T1   Chakraverty, "A.Post harvest technology for Cereals, Pulses and oilseeds", Oxford & IBH publication Pvt Ltd, New Delhi, Third Edition, 2000.

T2   Sahay, K.M., and Singh, K.K. "Unit operations of Agricultural Processing",Vikas publishing house Pvt. Ltd., New Delhi, 1994.

REFERENCE BOOKS:

R1   Pande, P.H. "Principles of Agriculture Processing", Kalyani Publishers, Ludhiana, 1994.

R2   Henderson, S.M. and R.L. Perry. "Agricultural Process Engineering". John Wiley and Sons, New York. 1955.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG5001	**OPERATION AND MAINTENANCE OF FARM MACHINERY LABORATORY**	0	0	4	2

Course Objective	• To expose the students with the practice of different farm machineries operation in the field. • To study the machineries used in Tillage, sowing, plant protection, harvesting and threshing operations • To acquire knowledge on Fits and tolerances and replacements in various agricultural machineries • To understand various adjustments of farm machines • To make the students capable of dismantling and reassembling of a different agricultural machineries.

S.NO	LIST OF EXPERIMENTS
1	Identification of major systems of a tractor and general guidelines on preliminary check measures before starting a tractor - procedure for starting, running and stopping the tractor.
2	Identification of components of power tiller, their maintenance and study on preliminary check measures and safety aspects before starting a power tiller procedure for starting, running and stopping the power tiller.
3	Field operation and adjustments of ploughs
4	Field operation and adjustments of harrows
5	Field operation and adjustments of cultivators
6	Field operation of sowing and planting equipment and their adjustments
7	Field operation of plant protection equipment
8	Field operation on mowers and reapers
9	Field operation of combine and determination of field losses
10	Field operation of threshers and their performance evaluation
11	Studies on methods of repair, maintenance and off-season storage of farm equipment
12	Opening and reassembly of disc harrows, determination and adjustment of tilt and disc angles
13	Hitching of agricultural implements and trailers
14	Study and operation of bulldozer
15	Visit to agro-manufacturers

During this course, students could

Course Outcome

CO1: Identify different farm equipment
CO2: Calculate and predict the actual field problem during the operation.
CO3: Trained to do adjustments of farm implements and Hitching of agricultural implements and trailers.
CO4: Give care and maintenance to the farm machinery implements.
CO5: Dismantle and assemble various machineries used in agriculture.

S.NO	LIST OF EQUIPMENTS REQUIRED	REQUIRED QUANTITY
1	Tractor	1
2	Power tiller	1
3	Disc plough	1
4	Disc harrow	1
5	Multi tyne cultivator	1
6	Paddy Transplanter	1
7	Seed drill	1
8	Sprayer	1
9	Mower	1
10	Weeder	1
11	Combine harvester (optional) – can be had as demonstration	1

TEXT BOOKS

T1   Jagdishwar Sahay. Elements of Agricultural Engineering. Standard Publishers Distributors

T2   Jain S. C. and Grace Philip. 2012. Farm Machinery – An Approach. Standard Publishers Distributors., New Delhi

T3   Ojha, T. P. and Michael, A. M. 2011. Principles of Agricultural Engineering Vol. I. Jain Brothers, New Delhi

T4   Yadav, R., and Solanki, H. B. 2009.Numericals and Short Questions in Farm Machinery, Power and Energy in Agriculture.New India Publishing Agency, New Delhi.

T5   Liljedahl, J. B., Turnquist, P. K., Smith, D. W., and Hokey, M. 2004. Tractors and Their Power Units. CBS Publishers and Distributers Pvt. Ltd, New Delhi

REFERENCES

R1   Jain, S.C. and C.R. Rai. Farm Tractor Maintenance and Repair. Standard publishers and

Distributors, New Delhi, 1999.

R2   Herbert L.Nichols Sr., Moving the Earth, D. Van Nostrand company Inc. Princeton, 1959.

R3   John A Havers and Frank W Stubbs, Hand book of Heavy Construction, McGraw – Hill

book Company, New York, 1971.

R4   Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units. Wiley Eastern Pvt. Ltd.,
New Delhi, 1997.

R5   Kepner, R.A., et al. Principles of farm machinery. CBS Publishers and Distributers, Delhi. 99, 1997.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG5002	POST HARVEST ENGINEERING LABORATORY	0	0	4	2

Course Objective

- To determine various engineering properties of agricultural materials for different Post Harvest operations.
- To make students familiar with different aspects of post-harvest technology and recent developments that have taken place in this field.
- To aware the student with technological changes occurring in this field along with pre and post-harvest operations.
- To provide more knowledge on various processing methods of harvested crops and storage of produces.
- To evaluate different post harvesting machineries.

S.NO	LIST OF EXPERIMENTS
1	Determination of moisture content of grains by oven method and moisture meter.
2	Determination of porosity of grains.
3	Determination of coefficient of friction and angle of repose of grains.
4	Testing of paddy thresher & paddy winnower.
5	Testing of groundnut decorticator & maize sheller
6	Evaluation of thin layer drier
7	Evaluation of L.S.U. drier.
8	Determining the efficiency of bucket elevator and screw conveyor
9	Evaluation of shelling efficiency of rubber roll sheller
10	Determining the oil content of oil seeds.
11	Visit to modern rice mill
12	Visit to pulse milling industry

Course Outcome

CO1: The student will acquire more knowledge on different material handling equipments

CO2: The students will determine various engineering properties of agricultural materials for different Post Harvest operations.

CO3: The students got familiarized with different aspects of post-harvest technology and recent developments that have taken place in this field.

CO4: The student will be equipped with the technological changes occurring in this field along with pre and post-harvest operations.

CO5: The students will evaluate different post harvesting machineries and different crop processing techniques.

S.NO	LIST OF EQUIPMENTS REQUIRED	REQUIRED QUANTITY
1	Hot air oven, Grain moisture meter	1
2	Porosity apparatus	1
3	Coefficient of friction apparatus	1
4	Angle of repose – round type and L type	1
5	Paddy thresher	1
6	Groundnut decorticator and maize sheller	1
7	Thin layer dryer	1
8	LSU dryer	1
9	Bucket elevator and screw conveyor	1
10	Rubber roll sheller	1
11	Oil expeller	1

REFERENCES

R1 Chakraverty, A. Post harvest technology for Cereals, Pulses and Oilseeds. Oxford & IBH Publication Pvt Ltd, New Delhi, Third Edition, 2000.

R2 Sahay, K.M., and Singh, K.K. Unit operations of Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 1994.

R3 Pande, P.H. Principles of Agriculture Processing. Kalyani Publishers, Ludhiana, 1994.

R4 Henderson, S.M. and R.L. Perry. Agricultural Process Engineering. John Wiley and Sons, New York. 1955.

R5 Mohsenin, N.N. Physical Properties of Plant and Animal Materials Gordon and Breach Publishers, Ludhiana, 1970.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG6201	Soil and Water Conservation Engineering	3	0	0	3

Course Objective	• To impart a thorough knowledge and understanding of the basic causes of soil erosion and the relevant mitigation strategies.
	• To enable the students to design appropriate watershed based soil conservation structures and rainwater harvesting systems.

Unit	Description	Instructional Hours
I	**MECHANICS OF WATER AND WIND EROSION** Soil Erosion – Causes and Conservation status in India - Mechanics of water erosion – Raindrop Splash erosion - Kinetic Energy of Raindrops - usage of Automatic Rain Gauge Chart - Sheet erosion, Rill erosion, Gully erosion and Ravines - Stream bank erosion – Classification of Gully - Mechanics of Wind Erosion - sand dunes and desertification – Special forms of Erosion – Landslides – Mass movements – Pedestal Erosion – Pinnacle Erosion – Soil Piping.	9
II	**ESTIMATION OF SOIL LOSS** Rainfall and Runoff Erosivity – Soil Erodibility - Runoff computation for soil conservation: SCS-CN method –Rational Formula - Universal Soil Loss Equation (USLE) – standard plot – Modified Universal Soil Loss Equation (MUSLE) – Revised Universal Soil Loss Equation (RUSLE)- Tolerance limit (T Value) of soil loss– Land use capability classification - Wind drift losses.	9
III	**WATERSHED BASED SOIL CONSERVATION** Agronomic practices: contour cultivation - strip cropping – tillage practices – Soil management practices – Mechanical Measures – Gully Control Structures: Drop Spillway, Drop Inlet, Chute Spillways – Contour, Graded and Compartmental Bunding – Bench Terracing for hill slopes – Broad based Terracing – Grassed waterways: Location, construction and maintenance — wind breaks and shelter belts- Landslide control measures - Afforestation	9
IV	**RAINWATER HARVESTING MEASURES** In-situ soil moisture conservation : Micro catchments, - Continuous Contour Trenching – Staggered Trenching – Random Tie Ridging – Crescent bunds - Farm ponds: Hydrologic, Hydraulic and Structural designs - , Construction and Protection – Check dams and Percolation Ponds - Earthen dam – Retaining wall – Recharge Wells	9

	SEDIMENT TRANSPORT AND YIELD	
V	Sediment: Sources – Types of sediment load – Mechanics of sediment transport – Suspension, Saltation and surface Creep- Estimation of bed load – Sediment Graph - Reservoir sedimentation: Basics - Factors affecting sediment distribution pattern. Rates of reservoir sedimentation - Silt Detention Tanks – Wind Erosion Sand Dunes and Desertification.	9

Total Instructional Hours   45

Course Outcome

CO1: The students will be able to gain fundamental knowledge on the concepts of erosion.

CO2: Students will obtain the knowledge of estimating soil erosion.

CO3: They get enriched with knowledge on Hydrologic, Hydraulic and Structural designs of soil and water conservation measures

CO4: Students can able to design Rainwater harvesting systems.

CO5: Students will receive concepts of sedimentation and detention tanks.

TEXT BOOKS:

T1   Suresh, R., "Soil and Water Conservation Engineering", Standard Publication, New Delhi, 2007.

T2   Ghanshyam Das, "Hydrology and Soil Conservation Engineering", Prentice Hall of India Private Limited, New Delhi, 2000.

T3   A. Vanoni , "Sedimentation Engineering", ASCE manual and Report on Engineering Practice No. 54, Edited by Vito. ASCE publishing, 2006

REFERENCE BOOKS:

R1   Murthy, V.V.N., "Land and Water Management Engineering", Kalyani Publishers, Ludhiana, 1998.

R2   Gurmail Singh, "A Manual on Soil and Water Conservation", ICAR Publication, New Delhi, 1982.

R3   Mal, B.C., "Introduction to Soil and Water Conservation Engineering", Kalyani Publishers, New Delhi, 2002

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG6202	FOOD AND DAIRY ENGINEERING	3	0	0	3

Course Objective	- To introduce the students to dairy industry, properties and processing of milk, manufacture of dairy products , sanitation and effluent treatment in dairy industry - To expose the students to the fundamental knowledge of food, its properties and different methods of food processing. - 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

Unit	Description	Instructional Hours
I	**PROPERTIES AND PROCESSING OF MILK** Dairy Industry – importance and status – Milk Types – Composition and properties of milk - Production of high quality milk - Method of raw milk procurement and preservation - Processing –Staining - Filtering and Clarification - cream separation – Pasteurization – Homogenization - sterilization, UHT processing and aseptic packaging – emulsification - Fortification.	9
II	**DAIRY PRODUCTS** Manufacture of Milk Powder - Processing of Milk Products - Condensed Milk - Skim milk – Buttermilk - Flavoured Milk, whey, casein, yoghurt and paneer - Manufacture of Butter - Cheese Ghee, ice creams and frozen desserts - standards for milk and milk products - Packaging of Milk and Milk Products - Cleaning and Sanitation - Dairy effluent treatment and disposal .	9
III	**FOOD AND ITS PROPERTIES, REACTION AND KINETICS** Constituents of food - thermal processing of foods - cooking, blanching, sterilization, pasteurization, canning - Interaction of heat energy on food components, reaction kinetics, Arrhenius equation, TDT curves - water activity, sorption behaviour of foods – isotherm models - monolayer value, BET isotherms, Raoult"s law, Norrish, Ross, Salwin - Slawson equations.	9
IV	**PROCESSING AND PRESERVATION OF FOODS** Coffee, Tea processing - Concentration of foods, freeze concentration - osmotic and reverse osmotic concentration - drying and dehydration of food - Tray, tunnel, belt, vacuum and freeze dryers - rehydration of dehydrated foods - Fat and oil processing, sources, extraction, methods and equipment, refining of oils, hydrogenation, manufacture of margarine - Food preservation methods - preservation by irradiation, microwave and dielectric heating of food.	10

| V | **PACKAGING AND QUALITY CONTROL**
Food packaging, importance, flexible pouches - retort pouches - aseptic packaging, granules, powder and liquid packaging machines - nanotechnology – principles - applications in food processing – food plant location - Quality control of processed food products - Factors affecting quality. | 8 |

| | **Total Instructional Hours** | 45 |

Course Outcome	CO1: The students will gain knowledge about Dairy and Food process engineering
	CO2: Understand the process of manufacturing of dairy products and thermal processing of food.
	CO3: Explain physical, mechanical, thermal, rheological and electrical properties of food material and appraise their importance in food processing
	CO4: Compare food drying systems and assess their limitations in applying different food products
	CO5:Design various milk processing equipment and evaluate their performance and quality

TEXT BOOKS:

T1   Chandra Gopala Rao," Essentials of Food Process Engineering". B.S. Publications,Hyderabad, 2006

T2   Walstra. P., Jan T. M. Wouters., Tom J. Geurts "Dairy Science and Technology", CRC press, 2005.

REFERENCE BOOKS:

R1   Subbulakshmi.G., and Shobha A. Udipi, "Food Processing and Preservation", New Age International Publications, New Delhi, 2007.

R2   Toledo, R.T., "Fundamentals of Food Process Engineering", CBS Publishers and Distribution, New Delhi, 1997.

R3   Tufail Ahmed., "Dairy Plant Engineering and Management", Kitab Mahal Publishers, Allahabad, 1997.

R4   John Wiley & Sons, "Dairy Science and Technology" Handbook, Volumes 1-3,1993.

R5   Charm, S.E., "Fundamentals of Food Engineering", AVI Pub.,Co.Inc, New York, 1997.

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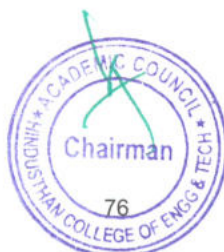
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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG6203	**PRECISION FARMING AND PROTECTED CULTIVATION**	3	0	0	3

Course Objective	• To impart knowledge on the protected all season confined space cultivation strategies for vegetables, fruits and flower crops
	• To sensitize the students on hi-tech production technology under open field Precision Farming applications.
	• To learn and practices the various production practices of flower and other high value crops

Unit	Description	Instructional Hours
I	**PROTECTED CULTIVATION FEATURES** Conceptual features of protected cultivation in horticultural crops - Importance and scope of protected cultivation – different growing structures of protected culture viz., green house, polyhouse, net house, poly tunnels, screen house, protected nursery house - study of environmental factors influencing green house production – cladding / glazing / covering material – ventilation systems – cultivation systems including nutrient film technique / hydroponics / aeroponic culture growing media and nutrients – canopy management – micro irrigation and fertigation systems.	9
II	**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.	9
III	**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.	9
IV	**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 – georeferencing and photometric correction –Sensors for information gathering – UAV - geostatistics – robotics in horticulture – postharvest process management (PPM) – Remote sensing.	9

PRECISION FARMING OF HORTICULTURAL CROPS

V	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.	9

Total Instructional Hours   45

Course Outcome   CO1: The students will be able to appreciate the different methods of protected cultivation practices available for vegetable crops and flowers.

CO2: A clear understanding of precision farming techniques and its application to horticultural crops is possible.

CO3: The students will be able to assess the technology available for vegetable crops

CO4: The students will be able to assess precision farming techniques using sensors and Geographic information systems for the crops

CO5: The students will be able to assess the technology available for horticulture crops

TEXT BOOKS:

T1   Joe.J.Hanan, "Green houses: Advanced Technology for Protected Horticulture", CRC Press, LLC. Florida. 1998

T2   Paul V. Nelson.," Green house operation and management". Ball publishing USA,1991.

REFERENCE BOOKS:

R1   Lyn. Malone, Anita M. Palmer, Christine L. Vloghat Jach Dangeermond, "Mapping out world: GIS lessons for Education". ESRI press.2002.

R2   David Reed, "Waer, media and nutrition for green house crops", Ball publishing USA.1996

R3   Adams, C.R. K.M. Bandford and M.P. Early, "Principles of Horticulture", CBS publishers and distributors. Darya ganj, New Delhi,1996.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG6204	BIO-ENERGY RESOURCE TECHNOLOGY	3	0	0	3

Course Objective	
	• To impart the fundamental knowledge on the importance of Bio resources, Bio energy and reactors
	• To understand the concepts and conversion systems in harnessing.
	• To apply the above concepts in meeting the energy needs in farm
	• Alcohol and ethanol production and Energy and Environment.

Unit	Description	Instructional Hours
I	**BIO RESOURCE - AN INTRODUCTION** Biochemical characteristics of bio-resources- Bio resource – origin – biomass types and characteristics- biomass conversion technology.	9
II	**BIOMETHNATION** Biodegradation - steps in biogas production- parameters affecting gas production- Types of biogas plants- Construction details- operation and maintenance. Slurry handling- enrichment and utilization – Biogas appliances- Bioenergetics – Biocatalysis –Kinetics of product formation.	9
III	**BIO REACTORS AND FERMENTORS** Bio reactors/ fermentors – Batch type – continuous stirred tank reactors- Biological waste water treatment- Activated sludge process- Downstream processing Recovery and purification of products.	9
IV	**THERMOCHEMICAL CONVERSION** Principles of thermochemical conversion – combustion - pyrolysis- Gasification – types of gasifiers. Alcohol ethanol production - Acid hydrolysis - enzyme hydrolysis-Methanol synthesis – Antibiotics enzymes.	9
V	**ENERGY AND ENVIRONMENT** Principles of operation- chemical reaction- cleaning and cooling - Utilization- Improved wood burning stove - Energy plantations- Biomass briquetting - co generation- Impact on Environment – Bioenergy policy.	9
	Total Instructional Hours	45

Course Outcome	
	CO1: The students will be able to understand the concepts of bio energy sources and its applications.
	CO2: Possess the knowledge on biochemical conversion technology and biofuels
	CO3: Possess the knowledge on reactors
	CO4: Possess the knowledge on thermal conversion technologies

TEXT BOOKS:

T1   Rai G.D, "Non-conventional sources of Energy", Khanna publishers, New Delhi, 1995.

T2   Bouley James .E & David Follis, " Biochemical Engineering Fundamentals", Mc Graw-Hill publishing company, Tokyo.1986

REFERENCE BOOKS:

R1   Chawla O.P, , "Advances in Biogas Technology", ICAR publication New Delhi 1986

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG6001	CAD FOR AGRICULTURAL ENGINEERING	0	0	4	2

Course Objective	To draft the agricultural engineering related machineries and structures manually and by computer aided methods.

S.NO	LIST OF EXPERIMENTS
1	Design and Drawing of Underground pipeline system
2	Design and Drawing of Check dam
3	Design and Drawing of Mould board plough
4	Design and Drawing of Disk plough
5	Design and Drawing of Post-harvest technology units (threshers and winnowers)
6	Design and Drawing of Biogas plant.
7	Introduction & demonstration on 3D modeling software's like Pro/E, Creo. Solid works, Solid Edge etc.

Course Outcome	CO1: The student will be able to understand the plan and layout of underground pipes, post harvesting units and check dams.
	CO2: The students also will be able to design and draw the components using computer aided methods.
	CO3: Apply knowledge of 3D modeling designs through software

S.NO	LIST OF EQUIPMENTS REQUIRED	REQUIRED QUANTITY
1	Computers	30
2	Licensed Software like CAD, Solid work, and Pro E	1

REFERENCES:

R1   Michael, A.M. "Irrigation Theory and Practice", Vikas Publishing House, New Delhi, 1999.

R2   Rai, G.D. "Nonconventional Sources of Energy", Khanna publishers, New Delhi. 1995.

R3   Srivastava, A.C."Elements of Farm Machinery", Oxford and IBH Publications Co., New Delhi, 1990.

R4   Vijay Duggal. "A general guide to Computer Aided Design & Drafting, Mailmax Publications, 2000

R5   Tadeusz Stolarski et al. "Engineering Analysis with ANSYS Software", Butterworth Heinemann Publications, 2006

R6   Louis Gary Lamit, "Introduction to Pro/ENGINEER" SDC Publications, 2004.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG 6002	**DRAWING OF FARM STRUCTURES**	0	0	4	2

Course Objective   To design various farm structures related to agriculture

S.NO	LIST OF EXPERIMENTS
1	Planning and Layout of farmstead
2	Design of stall bam
3	Design of loose housing and milk parlors
4	Design of poultry house
5	Design of a sheep / goat house
6	Design of ventilation system for dairy and poultry house
7	Design of silos – over ground and underground and hay storages
8	Design of farm fencing system
9	Design of machinery and equipment shed and workshops
10	Design of septic tank and sanitary structures
11	Design of rural/farm roads and culverts.

Course Outcome   CO1: At the end of the course, the student will be able to design and draw all farm structures connected to agricultural engineering including animal housing, grain storage, small civil structures.
CO2: Dismantle and assemble petrol engines, gear box and pumps
CO3: Prepare electrical connections for farm structures using suitable tools.

REFERENCES:

R1   Barre, H.J. and Sammet, L.L. "Farm Structures". John Wiley and Sons Inc. 1950."

R2   Neubaur, L. W. and Walker, H.B. "Farm Buildings Design". Prentice Hall Inc., 1961.

R3   Khanna, S.K. and Justo, C.E.G. "Highway Engineering". Nemchand and Bros., Roorkee,India.

R4   Dutta, B.N. "Estimating and Costing in Civil Engineering Theory and Practice". S. Dutta and Co.

R5   Bazirani, V.N. and Ratwani, M.M. "Steel Structures". Khanna Publishers, Delhi, 1981

R6   Justo, C.E.G. and Khanna, S.K. "Highway Engineering". Nemchand and Bros., Roorkee, India (Revised).

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG6003	FOOD AND DAIRY ENGINEERING LABORATOR	0	0	4	2

Course Objective   To get hands on experience on various aspects of food science and food process Engineering.

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

Course Outcome

CO1: On completion of the lab course, the students will be able to get experience on various aspects of food processing, preservation.

CO2: Compare food drying systems and assess their limitations in applying different food products

CO3: Distinguish thermal treatment techniques for food products and select suitable thermal processing method for food products based on their properties

S.NO	LIST OF EQUIPMENTS REQUIRED	REQUIRED QUANTITY
1	Extruder	1
2	Pasteurizer	1
3	Hot air oven	1
4	Hand refractometer.	1
5	Dessicator	1
6	Dean and Stark"s apparatus	1
7	Cabinet dryer	1
8	Soxhlet flask.	1
9	Distillation column	1
10	Kjeldahl flask	1
11	Distillation apparatus	1
12	Microwave oven	1
13	Cream separator	1
14	Butter churner	1

*Other basic requirements like weighing balance, physical balance, blotting papers, tracing sheets, burette, vernier calipers, pipette, conical flask, test tubes, beakers, spatula and other glasswares, food samples, chemicals should be available.

REFERENCES:

R1   Singh, R.Paul. and Heldman, R.Dennis, "Introduction to Food Engineerinn:, 3rd Edition. Academic Press, London,2004.

R2   Kessler, H.G. "Food engineering and dairy technology". Verlag A.Kessler, Freisingm1981.

R3   Walstra, P. T.J. Geurts, A. Nooman, A. Jellema and M.A. J.S Van Boékel; "DairyTechnology", Marcel Dekker Inc. New York,2005.

R4   Clunie Harvey, W.M and Harry Hill, "Milk Products", IV Edition Biotech Books, NewDelhi,2009.

R5   Robinson, R.K., " Modern dairy technology ", Vol.I Advances in Milk processing. Elsevier Applied Science Publishes, London, 1986.

R6   Karel Marcus, Fennama, R.Owen and Lund, B.Dayal, "Principles of food science," Part II - Physical principles of food preservation, Marcel Dakker, Inc.,1975.

R7   Hall,C.W and T.J.Hedrick, " Drying of milk and milk products", AVI Publishing Co.,West Port, Connecticut.,1971

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PROFESSIONAL ELECTIVE I

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG5301	SYSTEMS ANALYSIS AND SOFT COMPUTING IN AGRICULTURAL ENGINEERING	3	0	0	3

Course Objective	1. To introduce the students to the application of systems concept to agricultural engineering problems, planning and management.
	2. Soft computing techniques for modeling different problems in the field agricultural engineering

Unit	Description	Instructional Hours
I	**SYSTEM CONCEPTS** Definition, classification, and characteristics of systems – Scope and steps in systems engineering – Need for systems approach to water resources and irrigation.	9
II	**LINEAR PROGRAMMING & DYNAMIC PROGRAMMING** Introduction to operations research – Linear programming, problem formulation, graphical solution, solution by simplex method – Sensitivity analysis – application - Bellman's optimality criteria, problem formulation and solutions – application.	9
III	**SIMULATION** Basic principles and concepts – Random variate and random process – Monte Carlo techniques – Model development – Inputs and outputs – Deterministic and stochastic simulation – Irrigation Scheduling - application.	9
IV	**NEURAL NETWORKS** Neuron, Nerve structure and synapse, Artificial Neuron and its model, Neural network architecture: networks, Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory- Architecture: model, solution, single layer and multilayer perception model; back propagation learning methods, applications.	9
V	**FUZZY LOGIC AND GENETIC ALGORITHM** Basic concepts of fuzzy logic, Fuzzy set theory and operations, Properties of fuzzy sets, Membership functions, interference in fuzzy logic, Fuzzy implications and Fuzzy algorithms, Fuzzy Controller, Industrial applications. Genetic Algorithm (GA) - Basic concepts, working principle, procedures, flow chart, Genetic representations, encoding, Initialization and selection, Genetic operators, Mutation - applications	9

Total Instructional Hours 45

Course Outcome	CO1: Upon completion of the course, the student will have the knowledge on system concepts and will be able to apply the optimization techniques like LP, DP, FL and GA for problems in agriculture.
	CO2: Understand the linear programming & dynamic programming in agriculture.
	CO3: Understand the Random variate and random process
	CO4: understand the Various learning techniques of neuron network
	CO5: Learn the fuzzy logic and genetic algorithm

TEXT BOOKS:

T1 Vedula, S., and Majumdar, P.P. Water Resources Systems – Modeling Techniques and Analysis Tata McGraw Hill, New Delhi, Fifth reprint, 2010.

T2 Robert M Peart and W David Shoup, Agricultural Systems Management – Optimizing efficiency and performance, CRC Press, 2013.

T3 Gupta, P.K., and Man Mohan, "Problems in Operations Research", (Methods and Solutions), Sultan Chand and Sons, New Delhi, 1995.

REFERENCE BOOKS:

R1 Chaturvedi, M.C., "Water Resources Systems Planning and Management", Tata McGraw Hill, New Delhi, 1997.

R2 Taha, H.A., "Operations Research", McMillan Publication Co., New York, 1995.

R3 Hiller, F.S., and Liebermann, G.J., "Operations Research", CBS Publications and Distributions, New Delhi, 1992.

R4 Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.

R5 S. Raj Sekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" Prentice Hall of India.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG5302	SUSTAINABLE AGRICULTURE AND FOOD SECURITY	3	0	0	3

Course Objective	1. To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.
	2. To study various practices to conserve soil and water in a sustainable way.
	3. To inculcate the habit of sustainable farming in both rural and urban areas
	4. To get a basic idea about importance of science, food security and ecological balance.
	5. To know about various policies and schemes in order to encourage sustainable agriculture and maintain food security.

Unit	Description	Instructional Hours
I	**POTENTIAL LAND RESOURCES** Land Resources of India - Population and land - Land utilization Patterns - Net Area Sown - changes in cropping pattern – Monocropping – Multiple Cropping – Mixed Cropping - land degradation – causes and effects – delineation of Agricultural Lands – Lands for non-agricultural purposes – Forests and Wild Life areas – Coastal buffers – Usable Waste Lands – Industrial Zones – Sand dunes and Deserts – Urban space for Greenery and crop production – Terrace Cultivation prospects – Heat Island effects.	9
II	**SUSTAINABLE WATER RESOURCES** Rainfall forecasting - Adequacy of Rainfall for crop growth – Rainfall Analysis - Lands with buffer zones for Surface water resources - Drought and production instability – Irrigation potential – Available, created and utilized – River basins; Watersheds and Utilizable surface water – Utilizable water in future – Augmentation of Groundwater – Rainfall Runoff water harvesting – Lakes and Ponds – System and non-system Tanks – Farm Ponds, Check Dams and Percolation Ponds – Water Quality Indexing	9
III	**SUSTAINABLE RURAL AND URBAN 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 Rural Farming principles – Sustainability in rainfed farming – organic farming – principles and practices – Urban Farming – Protected Cultivation Structures – Terrace and Kitchen Gardening – Hydroponics and Aquaponics - domestic food processing units	9
IV	**CROP 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 - Sustainable food security indicators and index – Indicator of sustainability of food Security – Path to sustainable development.	9

	POLICIES AND PROGRAMMES	
V	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 – Regulations of Terrace Gardening product Market – Rainwater Harvesting – Biomechanical Filters – Water Quality Indexing for domestic and agricultural usage – Wastewater treatment and recycling procedures.	9

Total Instructional Hours   45

Course Outcome	CO1: Upon completion of this course, the students will gain knowledge on the need for sustainable agriculture
	CO2: They will be able to comprehend the need for food security on global level and the Nutritional Security.
	CO3: The students will be able to demonstrate how ecological balance is required for sustainability of agriculture.
	CO4: The students will be capable of understanding the applicability of rural and urban farming.
	CO5: The students will be able to identify various policies and programmes related to sustainable agriculture and food security.

TEXT BOOKS
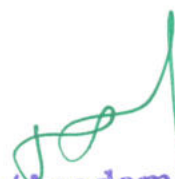
T1   M.S.Swaminathan, Science and sustainable food security, World Scientific Publishing Co., Singapore, 2010.

T2   B.K.Desai and Pujari, B.T. Sustainable Agriculture : A vision for future, New India Publishing Agency, New Delhi, 2007.

T3   Dhanarajan, Arulbalachandran, ed. Sustainable Agriculture Towards Food Security. Springer Singapore, 2017.

T4   Hatfield, Jerry L., David D. Songstad, and Dwight Thomas Tomes. Convergence of food security, energy security and sustainable agriculture. Springer, 2014.

T5   Campanhola, Clayton, and Shivaji Pandey, eds. Sustainable food and agriculture: an integrated approach. Academic Press, 2018.

REFERENCE BOOKS

R1   Swarna S.Vepaetal., Atlas of the sustainability of food security. MSSRF, Chennai, 2004.

R2   Sithamparanathan, J., Rengasamy, A., Arunachalam, N. Ecosystem principles and sustainable agriculture, Scitech Publications, Chennai, 1999.

R3   Tanji, K. K., and Yaron, B. Management of water use in agriculture, Springer Verlag, Berlin, Germany, 1994.

R4   Earles, Richard, and Paul Williams. Sustainable Agriculture an Introduction. ATTRA, 2005.

R5   Shetty, P. K., S. Ayyappan, and MonkombuSambasivan Swaminathan. Climate change and sustainable food security (NIAS Books and Special Publications No. SP4-2013). NIAS; ICAR, 2013.

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Program	Course Code	Name of the Course	L	T	P	C
B.E.	16AG5303	CDM AND CARBON TRADING TECHNOLOGY	3	0	0	3

Course Objective	1. To grab the basic idea about impact of greenhouse effect in environment.
	2. To acquire knowledge about various policies and programmes related to reduce the impacts of greenhouse effect.
	3. To know the basics, importance of clean development mechanism (CDM)
	4. To know the concept of carbon trading
	5. To introduce the alternatives for reducing the greenhouse effect.

Unit	Description	Instructional Hours
	GREEN HOUSE GASES AND ENVIRONMENTAL CHANGE	
I	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 - The conference of parties	9
	KYOTO PROTOCOL AND CDM PROJECTS	
II	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)	9
	TYPES AND FEATURES OF CDM	
III	Types of CDM-topology -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	9
	MONITORING OF CDM	
IV	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	9
	SUSTAINABLE ENERGY DEVELOPMENT	
V	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	9
	Total Instructional Hours	45

Course Outcome	CO1: Examine the effects of greenhouse gas emission and explain the responsibilities of countries in GHG emission
	CO2: Outline the KYOTO PROTOCOL and develop clean development mechanism (CDM) projects
	CO3: Explain the features of CDM and employ monitoring and auditing techniques on CDM projects
	CO4: Develop guidelines for small scale and Land Use, Land Use Change and Forestry (LULUCF) CDM projects
	CO5: Compare the alternate techniques for lowering carbon emission

TEXT BOOKS:

T1 MyungKyoon Lee, Baseline Methodologies for clean Development Mechanism Projects- A Guide Book- Vol.1, UNEP publication, 2005

T2 Myungkyoon Lee, Information and Guide Book - the UNEP project CD4CDM-UNEP publication, June 2004.

REFERENCE BOOKS:

R1 Manual for project developers and policy makers-UNFCCC Publication, 2007

R2 Aukland L, Bass S, Hug S, Landell Mals N, Tipper R, Laying the Foundations for clean Development, Preparing the Land use sector London, 2002

R3 Carbon sequestration in dryland soils, World Soil Resources report No.102, Food and Agriculture Organization, Rome, 2004.

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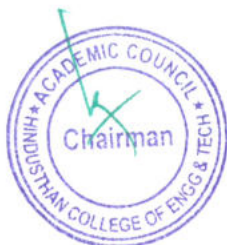
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Program	Course Code	Name of the Course	L	T	P	C
B.E.	16AG5304	IT IN AGRICULTURAL SYSTEMS	3	0	0	3

Course Objective

1. To impart the knowledge of electronic devices for the purpose automation in agricultural practice.
2. To get a basic idea about precision farming
3. To develop AI to control agricultural system and its management.
4. To acquire knowledge about system engineering in Agriculture
5. To know about e-governance in Agriculture Systems.

Unit	Description	Instructional Hours
I	**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	9
II	**PRECISION FARMING** Precision agriculture and agricultural management-Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.	9
III	**ENVIRONMENT CONTROL SYSTEM** Artificial light systems, management of crop growth in greenhouses, simulation of CO_2 consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture. Understanding and predicting world's climate system	9
IV	**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.	9
V	**E-GOVERNANCE 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.	9
	Total Instructional Hours	45

	During this course, students will be trained :
	CO1: To know the Basic of Electric Circuits
	CO2: To understand the importance of Precision Farming.
Course Outcome	CO3: To manage the favorable conditions required for every crops separately
	CO4: To solve the problems related to agriculture engineering by providing optimal conditions.
	CO5: Understand about e-governance and agricultural systems management.

TEXT BOOKS

T1	Hammer, G.L., Nicholls, N., and Mitchell, C., Applications of Seasonal Climate, Springer, Germany, 20
T2	Peart, R.M., and Shoup, W. D., Agricultural Systems Management, Marcel Dekker, New York, 2004.
T3	Joe.J.Hanan. 1998. Green houses: Advanced Technology for Protected Horticulture, CRC Press, LLC. Florida.
T4	Adams, C.R. K.M. Bandford and M.P. Early. 1996. Principles of Horticulture. CBS publishers and distributors. Darya ganj, New Delhi.
T5	Pierce FJ, Clay DE, editors. GIS applications in agriculture. New York: CRC Press; 2007 Feb 13.

REFERENCE BOOKS

R1	National Research Council, Precision Agriculture in the 21st Century, National Academies Press, Canada, 1997.
R2	H. Krug, Liebig, H.P. International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation, 1989.
R3	Gupta, P.K., and Man Mohan, "Problems in Operations Research", (Methods and Solutions), Sultan Chand and Sons, New Delhi, 1995.
R4	Srinivasan A, editor. Handbook of precision agriculture: principles and applications. CRC press; 2006 Sep 6.
R5	Clay DE, Clay SA, Bruggeman SA. Practical mathematics for precision farming. John Wiley & Sons; 2020 Jan 22.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG5305	EVAPOTRANSPIRATION AND SMART IRRIGATION	3	0	0	3

Course Objective

- To make the students understand the basic processes involved in the Evapo-transpiration (ET) routine of Crop Production.
- To expose the students to the learning of field and laboratory methods in arriving at reliable values of ET for Irrigation Scheduling.
- To impart the students with the fundamental understanding on different derived and empirical formulae involved in computing ET.

Unit	Description	Instructional Hours
I	**EVAPORATION AND TRANSPIRATION CONCEPTS** Conceptualization – Evaporation from Soil Surface and Water Bodies –Soil, Water and Plant Relationships - Transpiration through Vegetation – Metabolic Water Requirement – Consumptive Use – Factors affecting ET- weather parameters – Crop factors – Management and Environmental conditions – Reference Crop ET – standard and non-standard ET conditions – Potential ET	9
II	**MEASUREMENT OF EVAPOTRANSPIRATION** Direct Measurements - Evaporimeters – Open Pan Evaporimeter –Sunken Screen Pan Evaporimeter – Pichie's Evaporimeter – Weighing type Lysimeters – Non-weighing type (soil moisture depletion) Lysimeters – Leaf Area Index method – Air Temperature and Radiation method – Daylight length method — Empirical formulae – Blaney-Criddle method – Christiansen method – Lowry-Johnson method – Hargreave's method – Neutron Probe calibration and field usage.	12
III	**PENMAN-MONTEITH SEQUENCE OF ET** Reference Crop ET – Potential ET - Energy Balance method (Penman - Monteith fundamental formula) – Modified FAO Penman methods – data collection and interpretations – software development and usage – Crop oriented predictions – comparisons with open water bodies – solution to field based problems.	9
IV	**WATER PRODUCTION FUNCTIONS** Field Experimental Plots – curve fitting techniques – yield as function of PET and actual ET – point of inflection – point of tolerance –regressions – evaporation suppression – production boosting – effects of soil salinity	9
V	**WATER BALANCE AND WATER BUDGET** Book keeping procedure – hydrological water balance – onfarm water balance – on farm water budgeting – irrigation planning – Yield Vs moisture stress – management strategies.	6
	Total Instructional Hours	45

Course Outcome	CO1:The student gets an exposure to the environmental implications due to evapotranspiration losses in farm irrigation systems
	CO2: Calculate and measurement of evapotranspiration loss in crop field.
	CO3: Learn the data collection, interpretations and software development and its usage
	CO4: understand the basic functions and curve fitting techniques
	CO5:Caculate water balance and water budget

TEXT BOOKS:

T1. Michael, A.M., "Irrigation Theory and Practice", Vikas Publishing House, New Delhi, 1999.

T2. Asawa, G.L., "Irrigation Engineering", New Age International Private Limited, New Delhi,1996.

REFERENCE BOOKS:

R1. "Laboratory Manual", Centre for Water Resources, Anna University, Chennai

R2. Crop evapotranspiration-Guidelines for computing crop water requirements-FAO Irrigation and drainage paper 56

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PROFESSIONAL ELECTIVE II

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG6301	Climate Change and Adaptation	3	0	0	3

Course Objective
- To know the basics, importance of global warming
- To know the concept of mitigation measures against global warming
- To learn about the global warming and climate change.

Unit	Description	Instructional Hours
I	**EARTH'S CLIMATE SYSTEM** Role of ozone in environment - ozone layer - ozone depleting gases - Green House Effect - Radioactive effects of Greenhouse Gases - Hydrological Cycle - Green House Gases and Global Warming – Carbon Cycle.	9
II	**ATMOSPHERE AND ITS COMPONENTS** Importance of Atmosphere - Physical Chemical Characteristics of Atmosphere - Vertical structure of the atmosphere-Composition of the atmosphere-Atmospheric stability - Temperature profile of the atmosphere-Lapse rates-Temperature inversion - inversion on pollution dispersion.	9
III	**IMPACTS OF CLIMATE CHANGE** Causes of Climate change : Change of Temperature in the environment - Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem –Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.	9
IV	**OBSERVED CHANGES AND ITS CAUSES** Climate change and Carbon credits- CDM- Initiatives in India-Kyoto Protocol Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC– IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India .	9
V	**CLIMATE CHANGE MITIGATION MEASURES** Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding - Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW) & Bio waste - Biomedical, Industrial waste – International and Regional cooperation.	9

Total Instructional Hours   45

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After successful completion of this course students are expected to be able to:

Course

Outcome

CO1:Demonstrate an understanding of how the threats and opportunities of predicted climate change will influence specific sectors at global and regional scale

CO2:Critically evaluate the relative opportunities and needs for mitigation and adaptation (including vulnerability assessments) in a variety of sectoral contexts

CO3: Analyze the impacts of climate change on environment parameters

CO4: Understand and critically evaluate the scientific insights underlying the assessment reports of the IPCC, with a focus on impacts, adaptation and mitigation.

CO5: Critically evaluate the relative opportunities and needs for mitigation and adaptation (including vulnerability assessments) in a variety of sectoral contexts

TEXT BOOKS:

T1 Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.

REFERENCE BOOKS:

R1 "Adaptation and mitigation of climate change-Scientific Technical Analysis", Cambridge University Press, Cambridge, 2006.

R2 J.M. Wallace and P.V. Hobs, "Atmospheric Science", Elsevier / Academic Press 2006.

R3 Jan C. van Dam, "Impacts of Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG6302	**HEAT AND MASS TRANSFER FOR AGRICULTURAL ENGINEERS**	3	0	0	3

Course Objective	• 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

Unit	Description	Instructional Hours
	CONDUCTION	
I	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.	9
	CONVECTION	
II	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.	9
	RADIATION	
III	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	9
	HEAT EXCHANGERS	
IV	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	9
	MASS TRANSFER	
V	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.	9
	Total Instructional Hours	45

Course Outcome	CO1: Understand conduction, students will able to in different geometries
	CO2: Asses the concepts and types of conversion in heat transfer mechanism
	CO3: Recognize the radiation problems in various geometries
	CO4: Analyze the performance of heat exchangers and evaporators
	CO5: Understand the various modes of mass transfer and apply them in engineering problems

TEXT BOOKS:

T1   R. C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New AgeInternational private limited, New Delhi, 2010

T2   Yunus A. Cengel, Heat and Mass Transfer: a Practical Approach, Tata McGraw Hillpublishing Company private limited, New Delhi, 2007

REFERENCE BOOKS:

R1   J. P. Holman, Heat Transfer, Tata McGraw Hill publishing Company private limited, NewDelhi, 2009

R2   C. P. Kothandaraman and S. Subramanyan, Fundamentals of Heat and Mass Transfer, NewAge International private limited, New Delhi, 2014

R3   Heat and Mass Transfer, S Chand and Company, New Delhi, 2009

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG6303	DISASTER MANAGEMENT	3	0	0	3

Course Objective	- To provide students an exposure to disasters, their significance and types. - To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction - To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR) - To enhance awareness of institutional processes in the country and develop rudimentary ability to respond to their surroundings with potential disasters.

Unit	Description	Instructional Hours
I	**SITUATIONAL DISASTERS** Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc -Classification, Causes, Impacts including social,economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms ofcaste, class, gender, age, location, disability - Global trends in disasters: urban disasters,pandemics, complex emergencies, Climate change- Dos and Don"ts during various types of Disasters.	9
II	**DISASTER RISK REDUCTION (DRR)** Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority (SDMA) – Early Warning System – Advisories from Appropriate Agencies.	9
III	**VULNERABILITIES, IMPACTS AND DEVELOPMENTS** Factors influencing Disaster Vulnerabilities - differential impacts - Development projects - dams, embankments, Highways - Land use – Electricity Power Lines - Industrialization - Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.	9
IV	**DISASTER RISK MANAGEMENT** Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment	9

V	CATEGORICAL CASE STUDIES Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.	9

Total Instructional Hours   **45**

Course Outcome	The students will be able to
	CO1: Differentiate the types of disasters, causes and their impact on environment and society
	CO2: Assess vulnerability and various methods of risk reduction measures as well as mitigation.
	CO3: Draw the hazard and vulnerability profiles and Scenarios in the Indian context for Disaster damage assessment and management.
	CO4: Describe hazard and Vulnerability profile of India for natural disasters and formulate disaster damage assessment and management
	CO5: Evaluate methods of risk reduction measures for landslide, flooding, forest fire

TEXT BOOKS:

T1   Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423,2010.

T2   Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., ISBN-10: 1259007367, ISBN-13: 978-1259007361,2010.

T3   Gupta Anil K, Sreeja S. Nair. "Environmental Knowledge for Disaster Risk Management", NIDM, New Delhi, 2011

T4   Kapur Anu, " Vulnerable India: A Geographical Study of Disasters", IIAS and Sage Publishers, New Delhi, 2010.

REFERENCE BOOKS:

R1   "Govt. of India: Disaster Management Act , Government of India", New Delhi, 2005

R2   Government of India, National Disaster Management Policy,2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG6304	HORTICULTURAL CROP PROCESSING	3	0	0	3

Course Objective
- To impart knowledge and skill to the students on different unit operations in processing of horticultural crops
- To make the students understand the working principles of different machineries used for processing of fruits, vegetables and spices
- To prompt them get sufficient knowledge in the basics of selection of appropriate machines/ equipment.

Unit	Description	Instructional Hours
I	**PROCESSING OF HORTICULTURAL CROPS** Characteristics and properties of horticultural crops - Importance of processing - fruits and vegetables - spices and condiments - important for processing; Preservation Technology: General methods of preservation- physical/ chemical and other methods of preservation – advantages and limitations – Nutritive values and Health factors.	9
II	**PRELIMINARY PROCESSING SEQUENCES** Flowcharts for preparation of different finished products - Food supply chain - Sorting and grading equipments - Peeling: Different peeling methods and devices (manual peeling, mechanical peeling, chemical peeling, and thermal peeling) - Slicing of horticultural crops: equipment for slicing, shredding, crushing, chopping, juice extraction, etc. - Blanching: Importance and objectives - blanching methods - effects on food (nutrition, colour, pigment,texture)	9
III	**CHILLING AND FREEZING PRELUDES** Chilling and freezing: Application of refrigeration in different perishable food products - Thermophilic, mesophilic & Psychrophilic micro-organisms - Chilling requirements of different fruits and vegetables - Freezing of food - freezing time calculations – slow paced and fast freezing - Equipment for chilling and freezing (mechanical & cryogenic) - Effect on food during chilling and freezing. Cold Storage - heat load calculations - cold storage design - refrigerated vehicle and cold chain system.	9

DRYING AND PACKAGING

IV   Dryers for fruits and vegetables, Osmo-dehydration; Handling and transportation of fruits and vegetables, Pack house technology, Minimal processing; Common methods of storage, Low temperature storage, evaporative cooled storage, Controlled atmospheric storage, Modified atmospheric packaging; Post harvest management and equipment for spices; Packaging of horticultural commodities, Packaging requirements (in terms of light transmittance, heat, moisture and gas proof, micro organisms, mechanical strength). Different types of packaging materials commonly used for raw and processed fruits and vegetables products, bulk and retail packages and packaging machines.   9

GRADES AND QUALITY CONTROL

V   Quality control in Fruit and vegetable processing industry - Study of fruit graders, Study of peeler and slicer, Study of juicer and pulper - Study of blanching equipment, Testing adequacy of blanching - Study of cold storage and its design - Study of CAP and MAP storage - Minimal processing of vegetables - Preparation of value added products.   9

| | **Total Instructional Hours** | **45** |

By the end of the course the students will be able to

Course Outcome

CO1:Use the different types of sorting, grading, peeling, slicing, blanching and other equipment for processing of fruits and vegetables

CO2: Identify the suitable equipment, materials and methods for storage, processing, packaging and value addition of fruits and vegetables

CO3:Develop at least 4 types of value added products from fruits and vegetables

CO4:Understand the technical and management aspects of operation of fruits

CO5: To understand the grades and quality of horiculture crops

TEXT BOOKS:

T1   Pandey, R.H., "Post harvest Technology of fruits and vegetables (Principles and practices)". Saroj Prakashan, Allahabad,1997.

T2   Sudheer, K P. and Indira, V. "Post- Harvest Engineering of horticultural crops". New india Publishing House,2007.

REFERENCE BOOKS:

R1   Lal Giridhari, Siddappa and Tondon, " Preservation of fruits and vegetables". ICAR, New Delhi,2001.

R2   Srivastava and Sanjeev Kumar, "Fruit and vegetable preservation: principles and practices", Kalyani Publishers,2008

R3   Fellows, P, " Food Processing Technology", Woodhead,2008

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16AG6401	ROOF TOP GARDENING AND ORGANIC FARMING	3	0	0	3

Course Objective	• To impart knowledge to students on the importance of gardening and organic farming
	• To impart theoretical and practical knowledge on layout of different types of gardens and their maintenance.

Unit	Description	Instructional Hours
I	**Urban Agriculture** Importance and scope of Urban Agriculture- principles of gardening; types of gardens. Special types of gardens - roof garden, vertical garden, terrace garden.	9
II	**Professional Skills** Usage and maintenance of equipment's for gardening- Planting suitable varieties to suit different types of gardens- Install and maintenance of water fountains- design consideration and construction of roof garden.	9
III	**Importance of Organic farming** Organic farming, principles and its scope in India; Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture.	9
IV	**Certification process** Choice of crops and varieties in organic farming; Certification process and standards of organic farming; Processing, leveling, economic considerations and viability, marketing and export potential of organic products.	9
V	**Business Opportunity** Business Opportunity Identification- Import and Export certification -Market Survey and Business Plan Development- Planning and Risk Assessment.	9
		45

Course Outcome	CO1: Understand the Importance and scope of Urban Agriculture in India
	CO2: To identify design consideration and construction of roof garden in Urban
	CO3: Understand the role of Government and NGOs for promotion of organic agriculture.
	CO4: To know Certification process for organic product
	CO5: Will have gained all round knowledge of roof gardening and organic farming as an agri-business enterprise rather than as a community profession.

TEXT BOOKS:

T1 David (Ed) Fletcher, Rooftop Garden Design, Images Publishing Group Pty Ltd. ,(1 October 2015), ISBN-10 : 1864706465

T2 APRIL PHILIPS, RLA, FASLA Designing urban agriculture. ISBN: 978-1-118-07383-4. April 2013

T3 Peter V. Fossel .Organic Farming. Published:15 June 2014 Publisher:Voyageur Press ,ISBN: 9780760345719, 0760345716

REFERENCE BOOKS:

R1 http://ecoursesonline.iasri.res.in/course/view.php?id=152

R2 http://www.asci-india.com/BooksPDF/Gardener.pdf

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HindusthanCollegeofEngineering andTechnology

(AnAutonomousInstitution, Affiliatedto AnnaUniversity,Chennai
ApprovedbyAICTE,NewDelhi&AccreditedbyNAACwith'A'Grade)
ValleyCampus,PollachiHighways,Coimbatore,Tamilnadu.

CO'S, PO'S & PSO'S MAPPING

Academic Year : 2020-2021

Semester – I

Course Code & Name : 19HE1101/ TECHNICAL   ENGLISH

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	1	1	2	-	1	2	1	2	3	1	3	3	2
CO2	1	2	1	1	1	2	1	1	1	3	1	2	2	3
CO3	1	2	1	1	1	2	1	1	2	3	1	2	2	2
CO4	1	1	-	1	1	1	1	1	2	3	1	2	3	3
CO5	-	1	1	1	1	1	1	2	2	3	1	2	2	2
AVG	1	1.4	1	1.2	1	1.4	1.2	1.2	1.8	3	1	2.2	2.4	2.4

Course Code & Name : 19MA1102/ CALCULUS AND LINEAR ALGEBRA

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO3	3	3	3	3	3	-	-	-	-	-	-	2	1	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO5	3	3	3	2	3	-	-	-	-	-	-	2	2	2
AVG	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2

Course Code & Name : 19ME1101/BASICS OF CIVIL AND MECHANICAL ENGINEERING

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	1	1	-	-	1	-	-	-	-	-	1	3	3
CO2	3	1	1	-	-	1	-	-	-	-	-	1	3	2
CO3	3	1	1	-	-	1	-	-	-	-	-	1	2	2
CO4	3	1	1	-	-	1	-	-	-	-	-	1	3	2
CO5	3	1	1	-	-	1	-	-	-	-	-	1	3	2
AVG	3	1	1	-	-	1	-	-	-	-	-	1	2.8	2.2

Course Code & Name : 19PH1151/ APPLIED PHYSICS

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	2	1	1	1	-	-	-	-	-	1	2	1
CO2	3	3	1	1	2	-	-	-	-	-	-	1	3	3
CO3	3	2	1	2	2	-	-	-	-	-	-	1	3	3
CO4	3	2	3	2	3	1	-	-	-	-	-	1	2	2
CO5	3	2	3	2	2	2	-	-	-	-	-	1	2	3
AVG	3	2.2	2	1.6	2	1.333333	-	-	-	-	-	1	2.4	2.4

Course Code & Name : 19CY1151/ CHEMISTRY FOR ENGINEERS

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	2	-	2	1	1	-	-	-	-	1	1	1
CO2	3	2	2	-	2	1	-	-	-	-	-	1	1	-
CO3	3	2	2	-	2	1	1	-	-	-	-	1	1	-
CO4	3	2	2	2	2	1	-	-	-	-	-	1	1	1
CO5	3	2	2	-	2	1	-	-	-	-	-	1	1	1
AVG	3	2	2	2	2	1	1	-	-	-	-	1	1	1

Course Code & Name : 19CS1151/PYTHON PROGRMMING PRACTICES

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	3	3	-	2	-	-	-	-	-	-	2	2	2
CO2	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO3	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO4	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO5	2	3	3	-	2	-	-	-	2	-	-	2	2	2
AVG	2	3	3	-	2	-	-	-	2	-	-	2	2	2

Semester – II

Course Code & Name : 21HE2101/ BUSINESS   ENGLISH FOR ENGINEERS

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	2	1	1	1	2	1	2	2	3	-	3	1	-
CO2	2	1	1	1	1	2	2	2	2	3	-	2	-	1
CO3	2	2	1	1	1	2	2	2	2	3	1	3	1	-
CO4	2	2	1	1	2	2	2	2	3	3	1	3	1	1
CO5	1	1	1	1	1	2	2	1	2	3	1	3	1	1
AVG	1.6	1.6	1	1	1.2	2	1.8	1.8	2.2	3	1	2.8	1	1

Course Code & Name : 21MA2101/ DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-		2	2
CO4	3	3	3	2	2	-	-	-	-	-	-		2	2
CO5	3	3	3	3	3	-	-	-	-	-	-		2	2
AVG	3	3	3	2.4	2.4	-	-	-	-	-	-		2	2

Course Code & Name : 21AG2104/ PRINCIPLES OF FOOD SCIENCES

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	2			1	2	1		1				2	2
CO2	1	2	1	1	1	1							2	1
CO3	1	1	3		1	2							2	3
CO4	1	2	1	1	2	1							1	2
CO5	1	1	1	1	1	2	1		1				1	2
AVG	1	1.6	1.5	1	1.2	1.6	1		1				1.6	2

Course Code & Name : 21PH2151/ MATERIAL SCIENCE

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	1	1	1	1	-	-	-	-	-	1	2	1
CO2	3	3	1	1	2	-	-	-	-	-	-	1	2	2
CO3	3	2	1	2	2	-	-	-	-	-	-	1	2	3
CO4	3	3	1	2	2	1	-	-	-	-	-	1	2	2
CO5	3	2	2	3	2	1	2	-	-	-	-	1	2	3
AVG	3	2.4	1.2	1.8	1.8	1	2	-	-	-	-	1	2	2.2

Course Code & Name : 21CY2151/ ENVIRONMENTAL STUDIES

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	-		-	-	-	2	3	3	2	-	-	2	-
CO2	2	-		-	-	-	2	3	3	2	-	-	2	-
CO3	2	1		1	-	-	2	3	3	2	-	-	2	-
CO4	2	1		2	-	-	2	3	3	2	-	-	2	-
CO5	2	1		2	-	-	2	3	3	2	-	-	2	-
AVG	2	-		-	-	-	2	3	3	2	-	-	2	-

Course Code & Name : 21IT2151/ PROGRAMMING IN C

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	3	3	-	2	-	-	-	-	-	-	2	2	2
CO2	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO3	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO4	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO5	2	3	3	-	2	-	-	-	2	-	-	2	2	2
AVG	2	3	3	-	2	-	-	-	-	-	-	2	2	2

Course Code & Name : 21ME2001/ ENGINEERING PRACTICES

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	-	3	-	3	-	1	-	1	-	-	-	1	2
CO2														
CO3														
CO4														
CO5														
AVG	3		3		3				1				1	2

Semester – III

Course Code & Name : 21MA3102/ FOURIER ANALYSIS AND TRANSFORMS

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	3	3	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO3	3	3	3	3	2	-	-	-	-	-	-	2	2	1
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	1
AVG	3	3	3	3	2.6	-	-	-	-	-	-	2	2	1.2

Course Code & Name : 19AG3201 – SOIL SCIENCE AND ENGINEERING

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3		3			3	3	2	1		1	3		
CO2	3	2						2		1	1	2		

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO3	1		1	2	2	1			2			3		
CO4	2	1			2		1	2	1			1		
CO5	3	2	1	3		2	1	1	2	3	2	2		
AVG	2	1	2	2	2	2	2	1	1	2	1	2		

Course Code & Name : 19AG3202 – FLUID MECHANICS AND HYDRAULICS

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	1	1	1			2					3	1
CO2	2	2	1	1	2					3		1	2	1
CO3	3	1	1	1	3	1	1	1		2		1	2	2
CO4														
CO5														
AVG	2	2	1	1	2	1	1	1		2		1	2	1

Course Code & Name : 19AG3203 - Principles and practices of Crop Production

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	-	1	-	-	-	1	-	-	-	2	2	3	1
CO2	1	1	2	-	2	-	-	-	1	1	2	2	2	2
CO3	1	2	2	1	1	-	-	-	1	1	2	2	2	2
CO4	1	1	1	-	1	-	-	-	1	1	2	2	1	3
CO5	1	3	1	-	1	-	-	-	1	1	2	2	1	3
AVG	1	1	1	1	1		1		1	1	2	2	2	2

Course Code & Name : 19AG3251 – UNIT OPERATIONS IN AGRICULTURAL PROCESSING

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	1	1	1	1		2		3	2		3	1
CO2	2	2	1	1			2		3			1	2	1
CO3	3	1	1	1	3		2		1		1	1	2	2
CO4	3	1	1	1		2		3		3		1	1	2
CO5	3	2	1	1		3		2	3	1		1	1	1
AVG	3	2	1	1	2	2	2	2	2	2	1	1	2	1

Course Code & Name : 19AG3001 - Field Crop Production Practical

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	-	1	-	-	-	1	-	-	-	2	2	3	1
CO2	1	1	2	-	2	-	-	-	1	1	2	2	2	2
CO3	1	2	2	1	1	-	-	-	1	1	2	2	2	2

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO4	1	1	1	-	1	-	-	-	1	1	2	2	1	3
CO5	1	3	1	-	1	-	-	-	1	1	2	2	1	3
AVG	1	1	1	1	1		1		11	1	2	2	2	2

Course Code & Name : 19AG3002 - Soil Science Laboratory

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3		3			3	3	2	1		1	3	1	1
CO2	3	2		2				2		1	1	2	1	1
CO3	1		1		2	1			2			3	1	2
CO4	2	1		3	2		1	2	1	3		1	1	2
CO5	3	2	1			2	1	1	2	1	2	2	1	3
AVG	3	2	2	2	2	2	1	1	1	1	1	2	1	1

Semester – IV

Course Code & Name : 19AG4201 - Farm Tractors

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3		3			3	3	2	1		1	3	1	1
CO2	3	2		2				2		1	1	2	1	1
CO3	1		1		2	1			2			3	1	2
CO4	2	1		3	2		1	2	1	3		1	1	2
CO5	3	2	1			2	1	1	2	1	2	2	1	3
AVG	2	1	1	2	2	1	1	2	1	1	1	2	1	2

Course Code & Name : 19AG4202 - Thermodynamics

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	2										3	2
CO2	3		2			2							3	2
CO3		1	2	2										3
CO4	3		2									2		3
CO5	1	3	3	3								2		3
AVG	3	1	2	2		2						2	3	3

Course Code & Name : 19AG4203 - Irrigation and Drainage Engineering

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	1										1	1	1
CO2	3	3	3	3			1		3		3	2	3	2
CO3	1	1											1	2
CO4	3	3	2	2			1		2			2	2	3
CO5	2	2	1									1	1	2
AVG	2	1	2	2			1		2		3	1	1	2

Course Code & Name : 19MA4152/ STATSTICS AND NUMERICAL METHODS

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	3	1	2	-	-	-	-	-	-	2	3	2
CO2	3	3	3	2	1	-	-	-	-	-	-	3	2	2
CO3	3	3	3	1	1	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3		-	-	-	-	-	2	2	2
CO5	3	3	3	3	3		-	-	-	-	-	2	2	2
AVG	3	2.8	3	2	2							2.2	2.2	2

Course Code & Name : 19AG4251 BIO-ENERGY RESOURCE TECHNOLOGY

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	2	2									2	3	1
CO2	3	3	3	1	2	1	2		2	1	1	2	3	2
CO3	3	3	3	1	2	1	2		2	1	1	2	3	2
CO4	1		1	2	2	1						2	3	2
CO5	1											2	3	3
AVG	2	2.666667	2.25	1.333333	2	1	2	0	2	1	1	2	3	2

Course Code & Name : 19AG4252 SURVEYING AND LEVELING

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	1	1	2	1	2	1	1				1	1	1
CO2	2	1	1	2	1	2	1	1				1	1	1
CO3	3	1	2	3	2	3	1	1				1	1	2
CO4	3	2	2	2	2	3	2	1				2	1	2
CO5	3	2	3	2	3	3	2	2				32	1	3
AVG	2.6	1.4	1.8	2.2	1.8	2.6	1.4	1.2	0	**0**	0	1.4	1	1.8

Course Code & Name : 19AG4001 IRRIGATION FIELD LABORATORY

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	1										1	1	1
CO2	3	3	3	3			1		3		3	2	3	2
CO3	1	1											1	2
CO4	3	3	2	2			1		2			2	2	3
CO5	2	2	1									1	1	2
AVG	2	2	2	2.5	0	0	1	0	2.5	0	3	1.5	1.6	2

Semester – V

Course Code & Name : 16AG5201 REFRIGERATION AND COLD CHAIN MANAGEMENT

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	2	2									2	3	1
CO2	3	3	3	1	2	1	2		2	1	1	2	3	2
CO3	3	3	3	1	2	1	2		2	1	1	2	3	2
CO4	1		1	2	2	1						2	3	2
CO5	1											2	3	3
AVG	2	2.666667	2.25	1.333333	2	1	2	0	2	1	1	2	3	2

Course Code & Name : 16AG5202 FARM MACHINERY AND EQUIPMENT

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	1	2	2	2	1	3	2			1	3	3	3
CO2	2	2	3	3		1	2					3	2	3
CO3	2	2	3	3		1	2					3	2	3
CO4	2	2	3	3		1	2					3	2	3
CO5	2	2	3	3	1	1	2					3	2	3
AVG	1.8	1.8	2.8	2.8	1.5	1	2.2	2	0	0	1	3	2.2	3

Course Code & Name : 16AG5203 DESIGN OF FARM IMPLEMENTS AND MACHINERY

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	2	3	1		2	2					3	2
CO2	3	3	2	2	3	2	2		1				3	2
CO3	2	1	2	2	2	2	3		1				2	3

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PO&PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO4	3		2		1	2						2	2	3
CO5	2	3	3	2	3							2	2	3
AVG	2.6	2.25	2.2	2.25	2	2	2.33	2	1			2	2.4	2.6

Course Code & Name : 16AG5204 POST-HARVEST TECHNOLOGY

PO&PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	2	2	1	3	2			1	3	3	3
CO2	2	2	3	3		1	2					3	2	3
CO3	2	2	3	3		1	2					3	2	3
CO4	2	2	3	3		1	2					3	2	3
CO5	2	2	3	3	1	1	2					3	2	3
AVG	1.8	1.8	2.8	2.8	1.5	1	2.2	2	0	0	1	3	2.2	3

Course Code & Name : 19AG5301 - SYSTEMS ANALYSIS AND SOFT COMPUTING IN AGRICULTURAL ENGINEERING

PO&PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2									2	2	2
CO2	1	1	2	1	2	1	2	1	1	1	1	2	2	2
CO3	2	3	2	1	2	1	1		2	1	1	1	2	1
CO4	1	2	1	1	2	1		1				2	2	2
CO5	1											2	2	2
AVG	2	2	2	1	2	1	2	1	1	1	1	2	2	2

Course Code & Name : 16AG5302 - SUSTAINABLE AGRICULTURE AND FOOD SECURITY

PO&PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3			1						2	3	1
CO2	1	1	3	1	2	1	2		2	1	1	1	2	2
CO3	3	3	2	1	3	1	2	1	2	1	1	2	2	2
CO4	1		1	2	2	1	1		1		1	2	2	2
CO5	1											2	1	1
AVG	2	2	2	1	2	1	2	1	2	1	1	2	2	2

Course Code & Name : 16AG5303 - CDM AND CARBON TRADING TECHNOLOGY

PO&PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	1	2		2		2		3			

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO2	1	2	2	3	3			1				1		1
CO3	2	1	1	2		1			1	3		2		
CO4	1	3	2	1	2		3					1		1
CO5	2	2	1	3		3		1		1				
AVG	2	2	1	2	1	1	2	1	1	2	2	1	1	1

Course Code & Name : 16AG5304 - IT IN AGRICULTURAL SYSTEMS

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	2	1	3		2	1	1	3	2		2		1
CO2	2	3	2	1	3	3	3		2	1			2	
CO3	1	2	1	2	1	1	1	2	1	2		3	1	2
CO4	2	1	1	3			1	2	2	1	2			
CO5	1	2	1		2	2		1		3	3		2	1
AVG	1	2	1	2	2	2	2	2	2	2	2	2	2	1

Course Code & Name : 16AG5001 - OPERATION AND MAINTENANCE OF FARM MACHINERY LABORATORY

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	12	2	2	2	1	3	2			1	32	3	3
CO2	2	2	3	3		1	2					3	2	3
CO3	2	2	3	3		1	2					3	2	3
CO4	2	2	3	3	1	1	2					3	2	3
CO5	2	2	3	3	1	1	2					3	2	3
AVG	2	2	3	3	2	1	2	2			1	3	2	3

Course Code & Name : 16AG5002 - POST-HARVEST ENGINEERING LABORATORY

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	1	1	1	1		2		3	2	3	1	1
CO2	2	2	1	1			2		3		1	2	1	1
CO3	3	1	1	1	3		2		1		1	2	2	1
CO4	3	1	1	1		2		3		3		1	2	1
CO5	3	2	1	1		3		2	3	1		1	1	1
AVG	3	2	1	1	2	3	2	2	2	2	1	2	1	1

Semester – VI

Course Code & Name : 16AG6201 - SOIL AND WATER CONSERVATION ENGINEERING

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	1				1	2	1	1		1	2	3	1
CO2	3	3	3	3	3	2	3	1	3	2	22	3	3	2
CO3	3	3	3	3	2	2	3	1	3	3	3	3	3	2
CO4	2	2	2	2	2	2	3	1	2	3	3	3	3	2
CO5	1	1				1	2	1	1	1	1	2	3	3
AVG	2	2	3	3	2	2	3	1	2	2	2	3	3	2

Course Code & Name : 16AG6202 - FOOD AND DAIRY ENGINEERING

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	2			1	2	1		1				2	2
CO2	1	2	1	1	1	1							22	1
CO3	1	1	3		1	2							2	3
CO4	1	2	1	1	2	1							1	2
CO5	1	1	1	1	1	2	1		1				1	2
AVG	1	2	2	1	1	2	1		1				2	2

Course Code & Name : 16AG6203 - PRECISION FARMING AND PROTECTED CULTIVATION

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	2										3	2
CO2	3		2			2							3	2
CO3		1	2	2										3
CO4	3		2									2		3
CO5	1	3	3	3								2		3
AVG	3	2	2	3		2						2	3	3

Course Code & Name : 16AG6204 - BIO -ENERGY RESOURCE TECHNOLOGY

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	2	2									2	3	1

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO2	3	3	3	1	2	1	2		2	1	1	2	3	2
CO3	3	3	3	1	2	1	2		2	1	1	2	3	2
CO4	1		1	2	2	1						2	3	2
CO5	1											2	3	3
AVG	2	3	2	1	2	1	2	0	2	1	1	2	3	2

Course Code & Name : 16AG6301 - CLIMATE CHANGE AND ADAPTATION

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	2	2	1	3	2				3	3	3
CO2	2	2	3	3		1	2		2			3	2	3
CO3	2	2	3	3		1	2		2			3	2	3
CO4	2	2	3	3		1	3					3	2	3
CO5	2	2	3	3		1	2					3	2	3
AVG	2	2	3	3	2	1	2	2	2			3	2	3

Course Code & Name : 16AG6302 - HEAT AND MASS TRANSFERS FOR AGRICULTURAL ENGINEERS

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2		1		3	2	1		1	1	1	
CO2	2	1		3	2	1				2	3			2
CO3		3	2					3		1	1	2	2	
CO4	1	3	1	3		3				2				3
CO5		2			2		2		2		3		3	
AVG	3	2	1	3	2	2	2	2	1	2	1	1	2	2

Course Code & Name : 16AG6303 – DISASTER MANAGEMENT

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3		3	3		1		1			1	
CO2	2	3		2	1		2		2		3			
CO3	3	1	1		2	1						2	1	1
CO4	1	2		3	1		2	2		3				
CO5	1	2	2	1	2		1					1		1
AVG	1	2	2	2	2	2	2	1	2	2	3	3	1	1

Course Code & Name : 16AG6304 - HORTICULTURAL CROP PROCESSING

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	1	3	2	1	2	1	1	2	2	1	2	2	2
CO2	3	2	1	3	2	3	3	2	2	3	2	1	1	1
CO3	2	1	2	2	3	1	3			3	2	2	2	1
CO4	3	2		1	1	2		1	1	2	1	2	1	2
CO5	2	1		3	2	2	2	3	1			3	1	1
AVG	2	1	2	2	2	2	2	2	2	3	3	2	1	1

Course Code & Name : 16AG6401 - ROOFTOP GARDENING AND ORGANIC FARMING

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	3	2			3		1	2		1	2		1
CO2	1	2		3					3	2			2	
CO3	2	1			3	2	1		1			3		2
CO4	2	2	3				2	1			2			
CO5	1	3	1	2	1		3		2	1		2		1
AVG	1	2	2	2	2	2	2	1	2	1	1	2	2	1

Course Code & Name : 16AG6001 - CAD FOR AGRICULTURAL ENGINEERING

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2	2	3			2	2					3	2
CO2	3	3	2	2		2	2						3	2
CO3	2	1	2	2		2	3						2	3
CO4	3		2			2							2	3
CO5	2	3	3	2	3								2	3
AVG	3	2	2	2	3	2	2	2					2	3

Course Code & Name : 16AG6002 - DRAWING OF FARM STRUCTURES

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	1	2	3	1	2	3		2	2	2	3	2	2
CO2	1	3	1	2	2	2	2		1	2	1	2	2	1
CO3	2	2	2	3	2	1	2	1	3	2	2	2	1	1
CO4	2	2	1	3	1	1	2	1	2	1	2	1	2	1
CO5	1	1	1	2	1	1		1	2	1	1	1	1	1

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
AVG	2	2	1	3	1	1	2	1	2	2	2	2	2	1

Course Code & Name : 16AG6003 - FOOD AND DAIRY ENGINEERING LABORATORY

PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	2	2									2	3	1
CO2	3	3	3	1	2	1	2		2	1	1	2	3	2
CO3	3	3	3	1	2	1	2		2	1	1	2	3	2
CO4	1		1	2	2	1						2	3	2
CO5	1											2	3	3
AVG	2	3	2	1	2	1	2		2	1	1	2	32	2

![HICET Logo]

HindusthanCollegeofEngineering andTechnology

(AnAutonomousInstitution, Affiliatedto AnnaUniversity,Chennai
ApprovedbyAICTE,NewDelhi&AccreditedbyNAACwith'A'Grade)
ValleyCampus,PollachiHighways,Coimbatore,Tamilnadu.

MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME:

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E AGRICULTURE ENGINEERING (UG)

REGULATION-2019

Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
I	I	19HE1101 & Technical English	1	1	1	1	1	1	1	1	2	3	1	2	2	2
		19MA1102 & Calculus and Linear Algebra	3	3	3	3	3	-	-	-	-	-	-	2	2	2
		19ME1101 & Basics of Civil and Mechanical Engineering	3	1	1	-	-	1	-	-	-	-	-	1	3	2
		19PH1151 & Applied Physics	3	2	2	2	2	1	-	-	-	-	-	1	2	2
		19CY1151 & Chemistry for Engineers	3	2	2	2	2	1	1	-	-	-	-	1	1	1
		19CS1151 & Python programming and practices	2	3	3	-	2	-	-	-	2	-	-	2	2	2
I	II	19HE2101 & Business English for Engineers	2	2	1	1	1	2	2	2	2	3	1	3	1	1
		19MA2101 & Differential Equations and Complex Variables	3	3	3	2	2	-	-	-	-	-	-	2	2	2
		19AG2104 & Principles of Food Science	1	1	1	1	1	1	1	-	1	-	-	-	1	2

Year	Sem	Course														
		19PH2151 & Material Science	3	2	1	2	2	1	2	-	-	-	-	1	2	2
		19CY2151 & Environmental studies	2	1	1	-	-	1	2	3	2	-	-	2	-	-
		19IT2151 & Programming in C	2	3	3	-	2	-	-	-	-	-	-	2	2	2
		19ME2001 & Engineering Practices	3	-	3		3	-	-	-	1	-	-	-	1	2
II	III	19MA3102 & Fourier Analysis and Transforms	3	3	3	1	1	2	-	-	-	-	-	2	2	2
		19AG3201 & Soil Science and Engineering	2	1	2	2	2	2	2	1	1	2	1	2	1	1
		19AG3202 & Fluid Mechanics and Hydraulics	2	2	1	1	2	1	1	1	-	2	-	1	2	1
		19AG3203 & Principles and practices of Crop Production	1	1	1	1	1	-	1	-	1	1	2	2	2	2
		19AG3251 & Unit Operations in Agricultural Processing	3	2	1	1	2	2	2	2	2	2	1	1	2	1
		19AG3001 & Field Crop Production Practical	1	1	1	1	1	-	1	-	1	1	2	2	2	2
		19AG3002 & Soil Science Laboratory	3	2	2	2	2	2	1	1	1	1	1	2	1	1
II	IV	19AG4201 & Farm Tractors	2	1	1	2	2	1	1	2	1	1	1	2	1	2
		19AG4202 & Thermodynamics	3	1	2	2	-	2	-	-	-	-	-	2	3	3
		19AG4203 & Irrigation and Drainage Engineering	2	1	2	2	-	-	1	-	2	-	3	1	1	2
		19AG4251 & Bio-Energy Resource Technology	2	3	2	1	2	1	2	0	2	1	1	2	3	2
		19AG4252 & Surveying	3	1	2	2	2	3	1	1	0	0	0	1	1	1

		Course														
		and Leveling														
		19AG4001 & Irrigation Field Laboratory	2	2	2	3	0	0	1	0	3	0	3	1	2	2
III	V	19AG5201 & Farm Machinery and Equipment	2	2	3	3	2	1	2	2	0	0	1	3	2	3
		19AG5202 & Refrigeration and Cold Chain Management	2	3	2	1	2	1	2	0	2	1	1	2	3	2
		19AG5203 & Theory of Machines	2	2	2	2	2	1	1	1	1	1	1	1	2	2
		19AG5301 & Systems Analysis and Soft Computing in Agricultural Engineering	2	2	2	1	2	1	1	1	1	1	1	2	2	1
		19AG5302 & Sustainable Agriculture and Food Security	2	2	2	1	2	1	2	1	2	1	1	2	2	2
		19AG5303 & CDM and Carbon Trading Technology	2	2	2	2	2	1	1	1	1	1	1	1	2	2
		19AG5304 & IOT in Agricultural Systems	2	1	2	2	2	1	1	1	1	2	1	2	2	2
		19AG5305 & Ergonomics and Safety in Agricultural Engineering	2	1	2	1	2	1	2	1	2	1	1	2	2	2
		19AG5251 & Groundwater and Well Engineering	3	2	2	2	3	2	2	2	-	-	-	2	2	3
		19AG5252 & Soil and Water Conservation Engineering	2	2	3	3	2	2	3	1	2	2	2	3	3	2
		19AG5001 & Operation and Maintenance	2	2	2	3	2	-	1	0	3	0	3	2	2	2

		of Farm Machinery Laboratory														
		19AG5002 & CAD for Agricultural Engineering	3	2	2	2	3	2	2	2				2	2	2
III	VI	19AG6201 Hydrology and Water Resources Engineering	3	2	2	2	2	2	2	2	-	-	-	2	2	3
		19AG6202 Solar and Wind Energy Engineering	2	2	2	3	-	1	2	1	-	-	1	2	2	2
		19AG6181 Professional Ethics	2	3	2	1	2	1	2	-	2	1	1	2	3	2
		19AG6301 Climate change and adaptation	2	2	2	1	2	1	2	1	2	1	1	2	2	2
		19AG6302 Heat and Mass Transfers for Agricultural Engineers	1	2	2	1	1	2	1	-	1	-	-	-	2	2
		19AG6251 Food and Dairy Engineering	1	2	2	1	1	2	1	-	1	-	-	-	2	2
		19AG6252 ICT in Agricultural Engineering	2	2	2	2	1	2	2	-	1	2	2	2	2	2
		19AG6701 Industrial Training	3	2	2	3	-	2	-	-	-	-	-	2	3	3
		19AG6303 Disaster Management	2	2	1	2	2	2	2	1	1	1	1	2	2	2
		19AG6304 Horticultural Crop Processing	2	1	2	2	2	2	2	2	2	3	3	2	1	1
		19AG6305 Organic Farming Technologies	2	2	1	3	1	1	2	1	2	2	2	2	2	1
		19AG6401 Modern Agricultural Practices	2	2	3	3	2	1	2	2	2	-	-	3	2	3
IV	VII	19AG7201 Agricultural Extension	1	1	1	1	1	1	-	-	-	-	-	2	1	2

		Course														
		19AG7202 Remote Sensing and Geographical Information System	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		19AG7251 Precision Farming and Protected Cultivation	3	2	2	3	-	2	-	-	-	-	-	2	3	3
		19AG7001 Renewable Energy Laboratory	2	3	2	1	2	2	2	-	2	1	1	2	2	2
		19AG7002 GIS Laboratory for Agricultural Engineers	2	2	1	1	2	1	2	-	2	1	1	2	3	2
		19AG7901 Innovative Project	1	1	1	-	-	1	-	1	1	1	1	1	1	2
		19AG7301 Post-Harvest Technology	2	2	1	2	1	1	2	1	1	2	2	1	1	1
		19AG7302 Dairy Process Technology	2	2	2	1	1	2	2	1	1	2	1	2	2	1
		19AG7303 Storage and Packaging Technology	3	2	1	3	2	2	2	2	1	2	1	1	2	2
		19AG7304 Process Engineering of Fruits and Vegetables	1	2	1	2	2	2	2	2	2	2	2	2	2	1
		19AG7305 Fat and Oil Processing	1	2	2	2	2	2	2	1	2	1	1	2	2	1
		19AG7401 Urban Agriculture and organic farming	1	1	1	1	-	-	-	-	-	-	-	2	1	2
IV	VIII	19AG8901 Project work	1	2	1	-	-	1	-	1	1	1	1	1	1	2
		19AG8301 Agricultural Business Management and Entrepreneurship	2	2	1	1	2	2	2	2	1	2	1	2	1	1

Course														
19AG8302 On-Farm Water Management	1	2	2	2	2	2	2	1	2	2	3	3	1	1
19AG8303 Intellectual Property Rights	2	2	2	2	2	2	3	2	1	2	2	3	1	2
19AG8304 Agricultural Waste Management	1	2	1	2	2	2	2	2	2	2	2	2	2	1
19AG8305 Energy Conservation in Agro based Industry	1	2	2	2	2	2	2	1	2	1	1	2	2	1
19AG8306 Special Farm Equipment's	2	2	1	1	2	2	2	2	1	2	1	2	1	1
19AG8307 Mechanics of Tillage and Traction	2	2	2	2	2	2	3	2	1	2	2	3	1	2
19AG8308 Watershed Hydrology and Management	1	2	2	2	2	2	2	1	2	2	3	3	1	1
19AG8309 Micro Irrigation System	2	2	3	3	2	1	2	2	2	-	-	3	2	3
19AG8310 Agriculture Economics and Farm Management	2	2	1	3	1	1	2	1	2	2	2	2	2	1