B.Tech. (Agricultural Engineering)

2022 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY
An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade
SATHYAMANGALAM - 638401 ERODE DISTRICT TAMILNADU INDIA
Ph : 04295-226000/221289 Fax : 04295-226666 E-mail : stayahead@bitsathy.ac.in Web : www.bitsathy.ac.in

Stay Ahead

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VISION OF THE DEPARTMENT

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

MISSION OF THE DEPARTMENT

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

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. Excel in academic/professional career by acquiring knowledge and skill in engineering principles involved in agriculture

II. Analyze and improve agricultural operations through farm mechanization, land and water management, post-harvest handling and energy conservation to increase yield and land use efficiency

III. Develop professionalism in management, entrepreneurship, continuous learning and follow ethics to serve the society

PROGRAMME OUTCOMES (POs)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. 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.
4. 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.
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. 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.
11. 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.

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

PROGRAMME SPECIFIC OUTCOMES (PSOs)

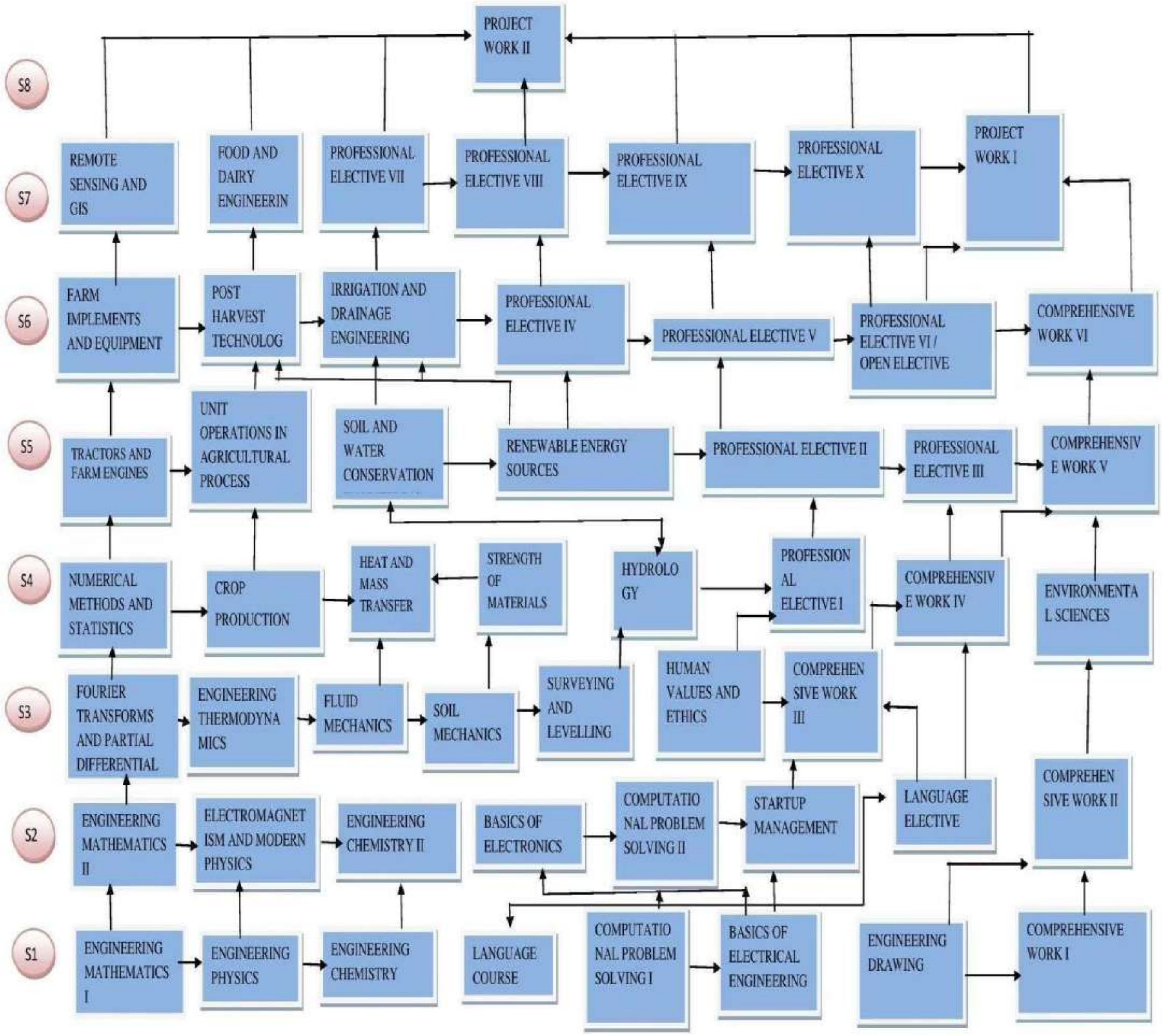
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

MAPPING OF PEOs AND POs

PEO(s)	Programme Outcomes(s)											
	1	2	3	4	5	6	7	8	9	10	11	12
I	X		X	X	X				X			
II		X	X	X	X			X				
III						X	X	X	X	X		


S8
S7
S6
S5
S4
S3
S2
S1
PROJECT WORK II
REMOTE SENSING AND GIS
FOOD AND DAIRY ENGINEERIN
PROFESSIONAL ELECTIVE VII
PROFESSIONAL ELECTIVE VIII
PROFESSIONAL ELECTIVE IX
PROFESSIONAL ELECTIVE X
PROJECT WORK I
FARM IMPLEMENTS AND EQUIPMENT
POST HARVEST TECHNOLOG
IRRIGATION AND DRAINAGE ENGINEERING
PROFESSIONAL ELECTIVE IV
PROFESSIONAL ELECTIVE V
PROFESSIONAL ELECTIVE VI / OPEN ELECTIVE
COMPREHENSIVE WORK VI
TRACTORS AND FARM ENGINES
UNIT OPERATIONS IN AGRICULTURAL PROCESS
SOIL AND WATER CONSERVATION
RENEWABLE ENERGY SOURCES
PROFESSIONAL ELECTIVE II
PROFESSIONAL ELECTIVE III
COMPREHENSIV E WORK V
NUMERICAL METHODS AND STATISTICS
CROP PRODUCTION
HEAT AND MASS TRANSFER
STRENGTH OF MATERIALS
HYDROLO GY
PROFESSION AL ELECTIVE I
COMPREHENSIV E WORK IV
ENVIRONMENTA L SCIENCES
FOURIER TRANSFORMS AND PARTIAL DIFFERENTIAL
ENGINEERING THERMODYNA MICS
FLUID MECHANICS
SOIL MECHANICS
SURVEYING AND LEVELLING
HUMAN VALUES AND ETHICS
COMPREHEN SIVE WORK III
LANGUAGE ELECTIVE
COMPREHEN SIVE WORK II
ENGINEERING MATHEMATICS II
ELECTROMAGNET ISM AND MODERN PHYSICS
ENGINEERING CHEMISTRY II
BASICS OF ELECTRONICS
COMPUTATIO NAL PROBLEM SOLVING II
STARTUP MANAGEMENT
ENGINEERING MATHEMATICS I
ENGINEERING PHYSICS
ENGINEERING CHEMISTRY
LANGUAGE COURSE
COMPUTATIO NAL PROBLEM SOLVING I
BASICS OF ELECTRICAL ENGINEERING
ENGINEERING DRAWING
COMPREHENSIVE WORK I

DEPARTMENT: AGRICULTURAL ENGINEERING
Minimum Credits to be Earned : 165

I SEMESTER

Code No.	Course	L	T	P	C	Hours / Week	Maximum Marks CIA	SEE	Total	Category
22MA101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
22PH102	ENGINEERING PHYSICS	2	0	2	3	4	50	50	100	BS
22CH103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
22GE001	FUNDAMENTALS OF COMPUTING	3	0	0	3	3	40	60	100	ES
22HS001	FOUNDATIONAL ENGLISH	1	0	2	2	3	100	0	100	HSS
22GE003	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
22GE005	ENGINEERING DRAWING	1	0	2	2	3	100	0	100	EEC
22HS003	தமிழர் மரபு HERITAGE OF TAMILS#*	1	0	0	1	1	100	0	100	HSS
22AG108	COMPREHENSIVE WORK$	0	0	2	1$	2	100	0	100	EEC
Total		15	1	10	21	26	-	-	-	-

II SEMESTER

Code No.	Course	L	T	P	C	Hours / Week	Maximum Marks CIA	SEE	Total	Category
22MA201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
22PH202	ELECTROMAGNETISM AND MODERN PHYSICS	2	0	2	3	4	50	50	100	BS
22CH203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
22GE002	COMPUTATIONAL PROBLEM SOLVING	3	0	0	3	3	40	60	100	ES
22GE004	BASICS OF ELECTRONICS ENGINEERING	2	0	2	3	4	50	50	100	ES
22HS002	STARTUP MANAGEMENT	1	0	2	2	3	100	0	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
22HS006	தமிழரும் தொழில்நுட்பமும் TAMILS AND TECHNOLOGY^*	1	0	0	1	1	100	0	100	HSS
22HS009	COCURRICULAR AND EXTRACURRICULAR ACTIVITY*	-	-	-	NC	-	100	0	100	HSS
Total		15	1	10	21	26	-	-	-	-

* Applicable for the students admitted during academic year 2024-2025. The lateral entry students have to complete these courses during III and IV semesters.
# Students admitted during academic year 2022-2023 studied this course in semester II.
^ Students admitted during academic year 2022-2023 studied this course in semester III.
$ Applicable only for the students admitted during academic year 2022-2023.

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AG301	NUMERICAL METHODS AND STATISTICS	3	1	0	4	4	40	60	100	BS
22AG302	SOIL SCIENCE AND ENGINEERING	3	0	2	4	5	50	50	100	ES
22AG303	ENGINEERING THERMODYNAMICS	3	1	0	4	4	40	60	100	PC
22AG304	FLUID MECHANICS AND MACHINERY	3	0	2	4	5	50	50	100	PC
22AG305	SURVEYING AND LEVELLING	3	0	2	4	5	50	50	100	ES
22HS004	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HSS
22HS005	SOFT SKILLS AND EFFECTIVE COMMUNICATION	0	0	2	1	2	60	0	100	EEC
Total		**17**	**2**	**8**	**23**	**27**	**-**	**-**	**-**	**-**

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AG401	CROP PRODUCTION TECHNOLOGY	3	0	2	4	5	50	50	100	PC
22AG402	HEAT AND MASS TRANSFER	3	0	2	4	5	50	50	100	PC
22AG403	STRENGTH OF MATERIALS	2	1	2	4	5	50	50	100	PC
22AG404	THEORY OF MACHINES	3	0	2	4	5	50	50	100	PC
22AG405	HYDROLOGY	3	1	0	4	4	40	60	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	40	60	100	PE
22HS007	ENVIRONMENTAL SCIENCE	2	0	0	0	2	100	0	100	HSS
22HS008	ADVANCED ENGLISH AND TECHNICAL EXPRESSION	0	0	2	1	2	60	40	100	EEC
22HS010	SOCIALLY RELEVANT PROJECT*	-	-	-	NC	-	100	0	100	HSS
Total		**19**	**2**	**10**	**24**	**31**	**-**	**-**	**-**	**-**

* Applicable for the students admitted during academic year 2024-2025.

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AG501	TRACTOR AND FARM ENGINES	3	0	2	4	5	50	50	100	PC
22AG502	UNIT OPERATIONS IN AGRICULTURAL PROCESS ENGINEERING	3	0	2	4	5	50	50	100	PC
22AG503	SOIL AND WATER CONSERVATION ENGINEERING*	3	1	0	4	4	40	60	100	PC
22AG504	RENEWABLE ENERGY SOURCES	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	40	60	100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	OE
22AG507	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		**18**	**1**	**8**	**23**	**27**	**-**	**-**	**-**	**-**

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AG601	FARM IMPLEMENTS AND EQUIPMENT	3	0	2	4	5	50	50	100	PC
22AG602	POST HARVEST TECHNOLOGY	3	0	2	4	5	50	50	100	PC
22AG603	IRRIGATION AND DRAINAGE ENGINEERING	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	40	60	100	PE
22AG607	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		**18**	**0**	**8**	**22**	**26**	**-**	**-**	**-**	**-**

* LTPC for this course is 3 0 0 3 for the students admitted during academic year 2022-2023.

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AG701	REMOTE SENSING AND GIS APPLICATIONS	2	0	2	3	4	50	50	100	PC
22AG702	FOOD AND DAIRY ENGINEERING	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	40	60	100	PE
22AG707	PROJECT WORK I	0	0	4	2	4	60	40	100	EEC
Total		**17**	**0**	**8**	**21**	**25**	**-**	**-**	**-**	**-**

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AG801	PROJECT WORK II	0	0	20	10	20	60	40	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	**-**	**-**	**-**	**-**

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	50	50	100	HSS
22HSH01	HINDI	1	0	2	2	3	50	50	100	HSS
22HSG01	GERMAN	1	0	2	2	3	50	50	100	HSS
22HSJ01	JAPANESE	1	0	2	2	3	50	50	100	HSS
22HSF01	FRENCH	1	0	2	2	3	50	50	100	HSS

PROFESSIONAL										
VERTICAL I - FARM MACHINERY										
22AG001	HUMAN ENGINEERING AND SAFETY	3	0	0	3	3	40	60	100	PE
22AG002	DESIGN OF AGRICULTURAL MACHINERY	3	0	0	3	3	40	60	100	PE
22AG003	TESTING AND EVALUATION OF FARM MACHINERY AND EQUIPMENT	3	0	0	3	3	40	60	100	PE
22AG004	FARM POWER AND MACHINERY MANAGEMENT	3	0	0	3	3	40	60	100	PE
22AG005	HYDRAULIC DRIVES AND CONTROLS	3	0	0	3	3	40	60	100	PE
22AG006	PRECISION FARMING EQUIPMENT	3	0	0	3	3	40	60	100	PE
VERTICAL II - SOIL AND WATER CONSERVATION ENGINEERING										
22AG007	BUILDING MATERIALS, ESTIMATION AND COSTING	3	0	0	3	3	40	60	100	PE
22AG008	GROUNDWATER, WELLS AND PUMPS	3	0	0	3	3	40	60	100	PE
22AG009	PROTECTED CULTIVATION	3	0	0	3	3	40	60	100	PE
22AG010	DESIGN OF MICRO IRRIGATION SYSTEMS	3	0	0	3	3	40	60	100	PE
22AG011	WATERSHED PLANNING AND MANAGEMENT	3	0	0	3	3	40	60	100	PE
22AG012	RESERVOIR AND FARM POND DESIGN	3	0	0	3	3	40	60	100	PE
22AG045	WATER HARVESTING TECHNIQUES	3	0	0	3	3	40	60	100	PE
VERTICAL III- AGRICULTURAL PROCESSING										
22AG013	REFRIGERATION AND COLD STORAGE	3	0	0	3	3	40	60	100	PE
22AG014	FRUITS AND VEGETABLES PROCESSING	3	0	0	3	3	40	60	100	PE
22AG015	STORAGE AND PACKAGING TECHNOLOGY	3	0	0	3	3	40	60	100	PE
22AG016	FOOD SAFETY MANAGEMENT SYSTEMS	3	0	0	3	3	40	60	100	PE
22AG017	EMERGING TECHNOLOGIES IN FOOD PROCESS ENGINEERING	3	0	0	3	3	40	60	100	PE
22AG018	FOOD PROCESS EQUIPMENT AND DESIGN	3	0	0	3	3	40	60	100	PE

VERTICAL IV - RENEWABLE ENERGY ENGINEERING										
22AG019	BIO AND THERMO CHEMICAL CONVERSION OF BIOMASS	3	0	0	3	3	40	60	100	PE
22AG020	SOLAR AND WIND ENGINEERING	3	0	0	3	3	40	60	100	PE
22AG021	ENERGY CONSERVATION IN AGRO BASED INDUSTRY	3	0	0	3	3	40	60	100	PE
22AG022	COGENERATION AND WASTE HEAT RECOVERY SYSTEMS	3	0	0	3	3	40	60	100	PE
22AG023	GREEN BUILDINGS	3	0	0	3	3	40	60	100	PE
22AG024	ENERGY STORAGE SYSTEMS	3	0	0	3	3	40	60	100	PE
22AG025	CDM AND CARBON TRADING TECHNOLOGY	3	0	0	3	3	40	60	100	PE
VERTICAL V - CROP PRODUCTION & PROTECTION										
22AG026	SOIL FERTILITY AND NUTRIENT MANAGEMENT	3	0	0	3	3	40	60	100	PE
22AG027	PLANT PROTECTION	3	0	0	3	3	40	60	100	PE
22AG028	EXTENSION METHODOLOGY AND TRANSFER OF TECHNOLOGY	3	0	0	3	3	40	60	100	PE
22AG029	AGRICULTURAL MARKETING	3	0	0	3	3	40	60	100	PE
22AG030	INTEGRATED FARMING SYSTEM	3	0	0	3	3	40	60	100	PE
22AG031	SUSTAINABLE AGRICULTURE AND FOOD SECURITY	3	0	0	3	3	40	60	100	PE
VERTICAL VI – SMART AGRICULTURE SYSTEMS										
22AG032	INSTRUMENTATION AND CONTROL ENGINEERING IN AGRICULTURE	3	0	0	3	3	40	60	100	PE
22AG033	DATABASE MANAGEMENT AND MICROPROCESSOR APPLICATIONS IN AGRICULTURE	3	0	0	3	3	40	60	100	PE
22AG034	DATA ANALYTICS IN AGRICULTURAL SYSTEMS	3	0	0	3	3	40	60	100	PE
22AG035	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FOR AGRICULTURE	3	0	0	3	3	40	60	100	PE
22AG036	MECHATRONICS IN AGRICULTURAL ENGINEERING	3	0	0	3	3	40	60	100	PE
22AG037	GEOINFORMATICS AND NANO TECHNOLOGY	3	0	0	3	3	40	60	100	PE

VERTICAL VII - AGRI BUSINESS AND ENTREPRENEURSHIP										
22AG038	AGRI BUSINESS MANAGEMENT AND ENTREPRENEURSHIP	3	0	0	3	3	40	60	100	PE
22AG039	AGRICULTURAL FINANCE, BANKING AND COOPERATION	3	0	0	3	3	40	60	100	PE
22AG040	TECHNOLOGY OF SEED PROCESSING	3	0	0	3	3	40	60	100	PE
22AG041	MUSHROOM CULTIVATION AND VERMICOMPOSTING	3	0	0	3	3	40	60	100	PE
22AG042	ENGINEERING ECONOMY AND PROJECT PLANNING	3	0	0	3	3	40	60	100	PE
22AG043	VALUE ADDITION OF INDIGENOUS FRUITS AND VEGETABLES	3	0	0	3	3	40	60	100	PE
22AG044	PRINCIPLES OF ORGANIC FARMING	3	0	0	3	3	40	60	100	PE

OPEN ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22OCS01	OBJECT ORIENTED PROGRAMMING	3	0	0	3	3	40	60	100	PE
22OCS02	JAVA FUNDAMENTALS	3	0	0	3	3	40	60	100	PE
22OCS03	KNOWLEDGE DISCOVERY IN DATABASES	3	0	0	3	3	40	60	100	PE
22OCS04	E LEARNING TECHNIQUES	3	0	0	3	3	40	60	100	PE
22OCS05	SOCIAL TEXT AND MEDIA ANALYTICS	3	0	0	3	3	40	60	100	PE
22OEC01	BASICS OF ANALOG AND DIGITAL ELECTRONICS	3	0	0	3	3	40	60	100	PE
22OEC02	MICROCONTROLLER PROGRAMMING	3	0	0	3	3	40	60	100	PE
22OEC03	PRINCIPLES OF COMMUNICATION SYSTEMS	3	0	0	3	3	40	60	100	PE
22OEC04	PRINCIPLES OF COMPUTER COMMUNICATION AND NETWORKS	3	0	0	3	3	40	60	100	PE
22OEI03	FUNDAMENTALS OF VIRTUAL INSTRUMENTATION	3	0	0	3	3	40	60	100	PE
22OEI04	OPTOELECTRONICS AND LASER INSTRUMENTATION	3	0	0	3	3	40	60	100	PE
22OBT01	BIOFUELS	3	0	0	3	3	40	60	100	PE
22OFD01	TRADITIONAL FOODS	3	0	0	3	3	40	60	100	PE
22OFT01	FASHION CRAFTSMANSHIP	3	0	0	3	3	40	60	100	PE
22OFT02	INTERIOR DESIGN IN FASHION	3	0	0	3	3	40	60	100	PE
22OFT03	SURFACE ORNAMENTATION	3	0	0	3	3	40	60	100	PE
22OPH01	NANOMATERIALS SCIENCE	3	0	0	3	3	40	60	100	PE
22OPH02	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	40	60	100	PE
22OPH03	APPLIED LASER SCIENCE	3	0	0	3	3	40	60	100	PE
22OPH04	BIOPHOTONICS	3	0	0	3	3	40	60	100	PE
22OPH05	PHYSICS OF SOFT MATTER	3	0	0	3	3	40	60	100	PE
22OCH01	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	PE
22OCH02	POLYMER SCIENCE	3	0	0	3	3	40	60	100	PE
22OCH03	ENERGY STORING DEVICES	3	0	0	3	3	40	60	100	PE
22OMA01	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	40	60	100	PE
22OGE01	PRINCIPLES OF MANAGEMENT	3	0	0	3	3	40	60	100	PE
22OGE02	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	40	60	100	PE
22OGE03	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	40	60	100	PE
22OGE04	NATION BUILDING, LEADERSHIP AND SOCIAL RESPONSIBILITY	3	0	0	3	3	40	60	100	PE

22OME01	DIGITAL MANUFACTURING	3	0	0	3	3	40	60	100	PE
22OME02	INDUSTRIAL PROCESS ENGINEERING	3	0	0	3	3	40	60	100	PE
22OME03	MAINTENANCE ENGINEERING	3	0	0	3	3	40	60	100	PE
22OME04	SAFETY ENGINEERING	3	0	0	3	3	40	60	100	PE

ONE CREDIT COURSES										
22AG0XA	HYDROPONICS FARMING OF HORTICULTURAL CROPS	0	0	0	1	0	100	0	100	EEC
22AG0XB	ENERGY AUDITING IN INDUSTRIAL SECTORS	0	0	0	1	0	100	0	100	EEC
22AG0XC	PROGRAMMING FOR AGRICULTURAL AUTOMATION	0	0	0	1	0	100	0	100	EEC
22AG0XD	MACHINERY SYSTEM FOR PRECISION AGRICULTURE	0	0	0	1	0	100	0	100	EEC
22AG0XE	APPLICATION OF DRONES IN AGRICULTURE	0	0	0	1	0	100	0	100	EEC
22AG0XF	VERTICAL FARMING	0	0	0	1	0	100	0	100	EEC

HONOURS DEGREE (With Specialization)*										
VERTICAL IV - RENEWABLE ENERGY ENGINEERING										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AGH19	BIO AND THERMO CHEMICAL CONVERSION OF BIOMASS	3	0	0	3	3	40	60	100	PE
22AGH20	SOLAR AND WIND ENGINEERING	3	0	0	3	3	40	60	100	PE
22AGH21	ENERGY CONSERVATION IN AGRO-BASED INDUSTRY	3	0	0	3	3	40	60	100	PE
22AGH22	COGENERATION AND WASTE HEAT RECOVERY SYSTEMS	3	0	0	3	3	40	60	100	PE
22AGH23	GREEN BUILDINGS	3	0	0	3	3	40	60	100	PE
22AGH24	ENERGY STORAGE SYSTEMS	3	0	0	3	3	40	60	100	PE
22AGH25	CDM AND CARBON TRADING TECHNOLOGY	3	0	0	3	3	40	60	100	PE

MINOR DEGREE (Other than Agricultural Students) *										
VERTICAL IV - RENEWABLE ENERGY ENGINEERING										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum**			**Category**
							CIA	**SEE**	**Total**	
22AGM19	BIO AND THERMO CHEMICAL CONVERSION OF BIOMASS	3	0	0	3	3	40	60	100	PE
22AGM20	SOLAR AND WIND ENGINEERING	3	0	0	3	3	40	60	100	PE
22AGM21	ENERGY CONSERVATION IN AGRO BASED INDUSTRY	3	0	0	3	3	40	60	100	PE
22AGM22	COGENERATION AND WASTE HEAT RECOVERY SYSTEMS	3	0	0	3	3	40	60	100	PE
22AGM23	GREEN BUILDINGS	3	0	0	3	3	40	60	100	PE
22AGM24	ENERGY STORAGE SYSTEMS	3	0	0	3	3	40	60	100	PE

MINOR DEGREE: SOIL AND WATER CONSERVATION ENGINEERING**									
22AGM001	BUILDING MATERIALS, ESTIMATION AND COSTING	3	0	0	3	3	40	60	100	PE
22AGM002	GROUNDWATER, WELLS AND PUMPS	3	0	0	3	3	40	60	100	PE
22AGM003	PROTECTED CULTIVATION	3	0	0	3	3	40	60	100	PE
22AGM004	WATER HARVESTING TECHNIQUES	3	0	0	3	3	40	60	100	PE
22AGM005	WATERSHED PLANNING AND MANAGEMENT	3	0	0	3	3	40	60	100	PE
22AGM006	RESERVOIR AND FARM POND DESIGN	3	0	0	3	3	40	60	100	PE

* Honor and Minor vertical courses offered for the students admitted during academic year 2022-2023.

** Minor vertical courses offered for the students admitted during academic year 2023-2024.

SUMMARY OF CREDIT DISTRIBUTION

S. No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	**BS**	10	10	8	-	-	-	-	-	28	17%	15%	20%
2	**ES**	6	8	4	8	-	-	-	-	26	16%	15%	20%
3	**HSS**	2	3	3	-	-	-	-	-	8	5%	5%	10%
4	**PC**	-	-	8	11	16	12	7	-	54	33%	30%	40%
5	**PE**	-	-	-	3	6	9	12	-	30	18%	10%	15%
6	**EEC**	3	-	1	1	1	1	2	10	19	11%	7%	10%
Total		21	21	23	23	23	22	22	10	**165**	100%	-	-

BS	-	Basic Sciences
ES	-	Engineering Sciences
HSS	-	Humanities and Social Sciences
PC	-	Professional Core
PE	-	Professional Elective
EEC	-	Employability Enhancement Course
CA	-	Continuous Assessment
ES	-	End Semester Examination

22MA101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- .To impart mathematical modeling to describe and explore real-world phenomena and data.
- .To provide basic understanding on Linear, quadratic, power and polynomial, exponential, and multi variable models
- .Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of polynomial equations

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Implement the concepts of mathematical modeling based on linear functions in Engineering.
2. Formulate the real-world problems as a quadratic function model
3. Demonstrate the real-world phenomena and data into Power and Polynomial functions
4. Apply the concept of mathematical modeling of exponential functions in Engineering
5. Develop the identification of multivariable functions in the physical dynamical problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
5	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

MATHEMATICS MODELING OF LINEAR FUNCTIONS

The geometry of linear equations - Formation of linear equations: Method of least squares and method of regression - Vector spaces: Basic concepts with examples - Linear combination - Eigen values and vectors

UNIT II **9 Hours**

MATHEMATICAL MODELING OF QUADRATIC FUNCTIONS

General form of a quadratic function - Basic relationships between the equation and graph of a quadratic function - Sum of squares error and the quadratic function of best fit - Quadratic forms: Matrix form - Orhtogonality - Canonical form and its nature

UNIT III **9 Hours**

MATHEMATICAL MODELING OF POWER AND POLYNOMIAL FUNCTIONS

Characteristics of the graphs of power and polynomial functions - Fitting of power and polynomial functions using the method of least squares - Local maxima and local minima of power and polynomial functions - Power series of functions with real variables, Taylors series, radius and interval of convergence - Tests of convergence for series of positive terms - comparison test, ratio test

UNIT IV **9 Hours**

MATHEMATICAL MODELING OF EXPONENTIAL FUNCTIONS

Concept of exponential growth - Graphs of exponential functions - Relationship between the growth factor and exponential growth or decline - Exponential equations have a variable as an exponent and take the form y = abx through least square approximation - Calculus of exponential functions - Exponential series - Characteristics

UNIT V **9 Hours**

MATHEMATICAL MODELING OF MULTIVARIABLE FUNCTIONS

Graphing of functions of two variables - Partial derivatives - Total derivatives - Jacobians - Optimization of multivariable functions with constraints - Optimization of multivariable functions without constraints

Total: 45+15=60 Hours

Reference(s)

1. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2016
2. B. S. Grewal, Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB, Khanna, 2014
3. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons2020
4. Thomas and Finney, Calculus and analytic Geometry, Fourteenth Edition, By Pearson Paperback, 2018

22PH102 ENGINEERING PHYSICS 2 0 2 3

Course Objectives

- Understand the concept and principle of energy possessed by mechanical system
- Exemplify the propagation and exchange of energy
- Identify the properties of materials based on the energy possession

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO12. Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Apply the work-energy theorem to analyze and optimize mechanical system performance
2. Analyze free and forced mechanical oscillations in vibrational energy systems
3. Analyze the propagation of energy in mechanical systems through transverse and longitudinal waves
4. Analyze the exchange of energy and work between the systems using thermodynamic principles
5. Apply the concept of energy and entropy to understand the mechanical properties of materials

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	2	-	-	1	-	-	-
2	3	2	1	2	-	-	-	-	2	-	-	1	-	-	-
3	3	2	2	1	-	-	-	-	2	-	-	1	-	-	-
4	3	2	2	1	-	-	-	-	2	-	-	1	-	-	-
5	3	2	2	1	-	-	-	-	2	-	-	1	-	-	-

UNIT I **6 Hours**

CONSERVATION OF ENERGY

Concept of energy - types of energy - conservation of energy Mechanical energy: - translation - rotation - vibration - Kinetic and potential energies - conservation - work and energy - laws of motion - minimization of potential energy - equilibrium - dissipative systems - friction

UNIT II **5 Hours**

VIBRATIONAL ENERGY

Periodic Motion - Simple Harmonic Motion - Energy of the SHM - Pendulum types - Damped oscillations - forced oscillations - natural frequency - resonance

UNIT III **6 Hours**

PROPAGATION OF ENERGY

Transfer of energy - material medium - Transverse wave - Longitudinal wave - standing wave - interference - Doppler effect. Sound waves and its types - characteristics - human voicere - reflection - refraction - beats

UNIT IV **7 Hours**

EXCHANGE OF ENERGY

Energy in transit - heat - Temperature - measurement - specific heat capacity and water - thermal expansion - Heat transfer processes. Thermodynamics: Thermodynamic systems and processes - Laws of thermodynamics - Entropy - entropy on a microscopic scale - maximization of entropy

UNIT V **6 Hours**

ENERGY IN MATERIALS

Elastic energy - Structure and bonding - Stress - strain - Tension and compression - elastic limit - Elastic Modulus - Stress - strain diagram - ductility - brittleness - rubber elasticity and entropy

5 Hours

EXPERIMENT 1

Assess the physical parameters of different materials for engineering applications like radius, thickness and diameter to design the electrical wires, bridges and clothes

5 Hours

EXPERIMENT 2

Evaluate the elastic nature of different solid materials for modern industrial applications like shock absorbers of vehicles

5 Hours

EXPERIMENT 3

Analyze the photonic behavior of thin materials for advanced optoelectronic applications like adjusting a patients head, chest and neck positions as a medical tool

5 Hours

EXPERIMENT 4

Investigate the phonon behavior of poor conductors for thermionic applications like polymer materials and textile materials

5 Hours

EXPERIMENT 5

Assess the elongation of different solid materials for industrial applications like buildings, bridges and vehicles

5 Hours

EXPERIMENT 6

Measure the compressibility of different liquids for modern industrial applications like navigation, medicine and imaging

Total: 60 Hours

Reference(s)

1. C J Fischer, The energy of Physics Part I: Classical Mechanics and Thermodynamics, Cognella Academic Publishing, 2019.
2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017

22CH103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Understand the origin of elements from the universe
- Outline the properties of elements in the periodic table
- Analyse the different types of bond formed during chemical reactions and its reaction thermodynamics
- Summarize different states of matter based on atomic arrangement

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Apply the principles of nuclear fusion and stellar evolution to explain the processes of hydrogen fusion in stars and the creation of elements
2. Apply the concept of atomic structure of elements in the periodic table to interpret the periodic trends in properties of elements with its anomaly
3. Apply the conditions for the formation of different types of chemical bonds and predict the minimum energy required for a reaction to occur
4. Analyze endothermic and exothermic processes and exchange of energy during chemical reactions
5. Analyze whether the given matter is a solid, liquid, gas, or plasma and interpret the arrangement of atoms

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **6 Hours**

ORIGIN OF ELEMENTS

Hydrogen - Elements and Sun - fusion - hypernova - supernova - dying stars - man-made elements

UNIT II **6 Hours**

ATOMIC STRUCTURE AND PERIODICITY

Atomic Structure - Electronic configuration - Periodic Table - Periodic trends in properties of elements - Anomalous behaviour in periodicity

UNIT III **6 Hours**

CHEMICAL BONDING

Octet rule & its limitations - types of chemical bonds - bond energy - bond cleavage - activation energy of reactions

UNIT IV **6 Hours**

REACTION THERMODYNAMICS

Conservation of energy - Endothermic reactions & exothermic reactions - Exchange of energy involved in chemical reactions

UNIT V **6 Hours**

STATES OF MATTER

Solid - liquid - gas - plasma - quantum dots - arrangement of atoms/ions/molecules in different phases

2 Hours

LABORATORY EXPERIMENTS

Lab safety rules and guidelines for students - OSHA Guidelines

4 Hours

EXPERIMENT 1

Evaluate the dissolved oxygen (DO) levels in effluent samples collected from sewage treatment plants in BIT. Ensure the suitability of outlet water for the growth of aquatic animals (fishes).

4 Hours

EXPERIMENT 2

Investigate the amount of Iron (Fe2) in a mild steel alloy sample using a spectrophotometer.

4 Hours

EXPERIMENT 3

Estimate the amount of chromium present in industry effluent samples and bottled beverages.

4 Hours

EXPERIMENT 4

Ensure the suitability of drinking water in the RO water supply in BIT based on the presence of chloride ions.

4 Hours

EXPERIMENT 5

Assess the acidic nature of effluent water from industries using the conductometric titration method.

4 Hours

EXPERIMENT 6

Measure the stain removal efficiency of the prepared soaps from stained clothes.

4 Hours

EXPERIMENT 7

Assess the purity of commercially available active pharmaceutical ingredients (aspirin) as per the government-prescribed standards.

Total: 60 Hours

Reference(s)

1. Peter Atkins, Physical Chemistry, Oxford university press, 2019
2. Rose Marie Gallagher and Author Paul Ingram, Complete Chemistry Cambridge IGCSE, Oxford university press, 2020
3. P L Soni, Text book of inorganic chemistry, Chand publishers, New Delhi, 2017
4. J.D. Lee, Concise inorganic chemistry, Blackman Science Ltd, France, Wiley-India, 5th edition (Reprint), 2016
5. Gareth Price, Thermodynamics of chemical processes, Oxford university press, 2019
6. D Tabor, Gases, liquids and solids and other states of matter, Oxford University press, 2018

22GE001 FUNDAMENTALS OF COMPUTING 3 0 0 3

Course Objectives

- Understand the fundamental digital logics behind computations of computer systems.
- Develop simple assembly language programs with respect to arithmetic operations.
- Understand the program execution process and basics of software development methodologies.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Infer the hidden languages and inner structures of computer hardware and software through codes and combinations.
2. Interpret the organizational and architectural issues of a digital computer with concepts of various data transfer techniques in digital computers and the I/O interfaces.
3. Analyze programming problems and apply assembly instructions to solve simple problems.
4. Infer the fundamentals of operating system and System programs basics.
5. Apply the software development methodologies to various real life scenarios.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-
2	3	3	3	1	-	-	-	-	-	-	-	-	-	-	-
3	2	2	2	1	-	-	-	-	-	-	-	-	-	-	-
4	2	2	2	1	-	-	-	-	-	-	-	-	-	-	-
5	2	2	2	1	-	-	-	-	-	-	-	-	-	-	-

UNIT I **8 Hours**

CODES AND COMBINATIONS

Communication using Mores and Braille binary codes - Digitizing letters, numbers and objects using binary codes - Performing simple operations: addition through binary codes.

UNIT II **9 Hours**

COMPUTATION USING COMPUTER

Communication to computing devices through various input sources - Computational operation - flow, functions and controls - communication to output devices - Basic communication protocol.

UNIT III **11 Hours**

ASSEMBLY LANGUAGE PROGRAMMING

Little Man Computing (LMC) Model - Instruction Set - Labels - Calculation -Branching - Input - Output - Loops - Simple programs.

UNIT IV **9 Hours**

OPERATING SYSTEM AND APPLICATION GENERATION

BIOS - Device Drivers - Resources - Scheduler - Applications Generation and Creation - Stages of Compilation - Linkers, Loaders and Libraries.

UNIT V **8 Hours**

SOFTWARE DEVELOPMENT

Phases of application life cycle management - Software Development Methodologies - Web Page development.

Total: 45 Hours

Reference(s)

1. Charles Petzold, "Code: The Hidden Language of Computer Hardware and Software", Microsoft Press books, 2009.
2. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
3. Andrew Eliaz, "Little Man Computer Programming: For The Perplexed From The Ground Up", The Internet Technical Bookshop; 1st edition, 2016.
4. Abraham Silberschatz, "Peter Baer Galvin and Greg Gagne, Operating System Concepts", 9th Edition, John Wiley & Sons Pvt. Ltd, 2015.
5. Roger S. Pressman, "Software Engineering: A Practitioner""s Approach", McGraw Hill International edition, Seventh edition, 2010

22HS001 FOUNDATIONAL ENGLISH **1 0 2 2**

Course Objectives

- Heighten awareness of grammar in oral and written expression
- Improve speaking potential and reading fluency in formal and informal contexts
- Prowess and develop abilities as critical readers and writers in interpreting complex texts.

Programme Outcomes (POs)

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. 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.
PO12. Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Express themselves in a professional manner using error-free language
2. Express in both descriptive and narrative formats
3. Interpret and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

UNIT I **15 Hours**

SELF-EXPRESSION

Self-Introduction-Recreating Interview Scenarios (with a focus on verbal communication)-Subject Verb Concord - Tenses - Common Errors in verbal communication Be-verbs Self-Introduction- Recreating interview scenarios-Haptics-Gestures-Proxemics-Facial expressions- Paralinguistic / Vocalic- Body Language- Appearance-Eye Contact-Artefacts Self-Introduction-Powerful openings and closings at the interview-Effective stock phrases - Modified for spontaneity and individuality-Question tags, framing questions including WH- questions- Prepositions-Listening to Ted talks-Listening for specific information

UNIT II **15 Hours**

CREATIVE EXPRESSION

Descriptive Expression-Picture Description and Blog Writing -Vocabulary-One-word substitution-Adjectives-Similes, Metaphors, Imagery & Idioms -Link words - Inclusive language Narrative Expression-

Travelogue and Minutes of Meeting -Verbal Analogy-Sequence & Time order words - Jumbled paragraph, sentences, Sequencing-Text & Paragraph Completion-Past tense -Using quotation marks

UNIT III **15 Hours**

FORMAL EXPRESSION

Formal Letters and Emails-Writing: E-mails and Letters of apology, Requisition and Explanation, and Letters to newspapers-Speaking: Tendering verbal apologies, and explanations, persuading a listener/ audience-Hierarchy in Business correspondence- Subject of a mail, Header, Body (Salutation) and Footer of a mail- Conjunctional clause Punctuation-Formal Idioms-Phrases-Articles - Definite & Indefinite-Types of sentences-Modal verbs Precision in comprehension, Summary writing, Selective summary-Reading: Active reading- short paragraphs, excerpts, articles and editorials-Skimming and Scanning Reading comprehension & analysis- Tenses, QP/ PQ approach. Identifying the central themes/ crux-Interpreting tone - formal/informal/semi-formal-Note-taking-Listening: Listening for data, for specific information, for opinion-Active and passive Listening-Transcription-Paraphrasing and summarizing information-Agreeing & disagreeing-Note-taking-Writing: Summary writing, selective summary, paraphrasing, note-making, opinion pieces-Finding synonyms in the context Paraphrasing- Sentence Transformation - simple, compound, complex. Sentence Substitution-Sentence completion- Interpreting paragraphs

Total: 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking Foundation Books, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010
4. Reynolds, John. Cambridge IGCSEÃ‚Â® First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

22GE003 BASICS OF ELECTRICAL ENGINEERING 2 0 2 3

Course Objectives

- To understand the basic concepts of electrical charge and its properties
- To interpret the formation of electric field due to electric charges
- To illustrate the concept of magnetic fields due to revolving electron
- To illustrate the force on moving charges in electric and magnetic field
- To understand the energy transfer in electro mechanical conversion

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO4. 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.
PO11. 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.
PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Interpret the behavior of electric charges in different medium using coulombs law.
2. Analyse the electric field due to different charge distributions.
3. Analyse the magnetic field intensity due to long conductor, solenoid, toroid and magnetic dipoles.
4. Analyze the force on conductors due to the moving charges.
5. Interpret the energy conversion concepts in electromagnetic fields.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	-	-	-	-	-	-	2	2	-	-	-
2	2	2	2	3	-	-	-	-	-	-	3	2	-	-	-
3	2	2	1	3	-	-	-	-	-	-	2	2	-	-	-
4	3	2	1	2	-	-	-	-	-	-	2	2	-	-	-
5	2	2	-	-	-	-	-	-	-	-	2	2	-	-	-

UNIT I **5 Hours**

ELECTRIC CHARGE

Properties of charge, additivity of charges, quantization of charge, conservation of charge, Forces between multiple charges, Electric charge in conductors, Drift of Electrons, Charges in Clouds.

UNIT II **7 Hours**

ELECTRIC FIELD

Electric field due to system of charges, Significance of Electric field line. Electric Dipole and its significance, Continuous charge distribution, Field in infinite long uniform straight conductors, field in uniform charged uniform infinite plane sheet, field due to uniform thin spherical sheet.

UNIT III **7 Hours**

MAGNETIC FIELDS

Concept of magnetic field, magnetic fields in infinitely long straight wire, straight and toroidal solenoids, Magnetic dipole moment of a revolving electron, Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to axis, Induced Electric field due to changing Magnetic Field.

UNIT IV **6 Hours**

FORCE ON CHARGES

Force on a moving charge in uniform magnetic and electric fields, Force on a current carrying conductor in a uniform magnetic field, Force between two parallel current carrying conductors.

UNIT V **5 Hours**

ELECTRO MECHANICAL ENERGY CONVERSION

Energy transfer in electromagnetic fields, Energy storage in magnetic field, Electromagnetic induction, induced emf, Eddy currents. Self and mutual inductance Linear Momentum and Angular Momentum carried by Electromagnetic Fields.

EXPERIMENT 1 **6 Hours**

Analysis the Behaviour of a Fixed Resistor in An Electric Heater.

EXPERIMENT 2 **9 Hours**

Construct an Electrical Wiring Layout for a Basic Household Applications.

EXPERIMENT 3 **6 Hours**

Analysis the Self and Mutual Induction in a Domestic Fan.

EXPERIMENT 4 **9 Hours**

Design a Transistor-Based Electronic Switch.

Total: 60 Hours

Reference(s)

1. Mathew N. O. Sadiku, Principles of Electromagnetics, 6th Edition, Oxford University 2020
2. William H. Hayt and John A. Buck, Engineering Electromagnetics, McGraw Hill 2020
3. Kraus and Fleisch, Electromagnetics with Applications, McGraw Hill International Editions, 2017
4. S.P.Ghosh, Lipika Datta, Electromagnetic Field Theory, First Edition, McGraw Hill Education(India) Private Limited 2017

22GE005 ENGINEERING DRAWING 1 0 2 2

Course Objectives

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

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO10. 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.
PSO1. Implement new ideas on product / process development by utilizing the knowledge of design and manufacturing.

Course Outcomes (COs)

1. Understand the engineering drawing concepts as per industrial standards.
2. Construct orthographic projections of points and lines.
3. Draw the projection of planes and simple solids.
4. Draw the section of solids and development of surfaces.
5. Draw the orthographic projection from isometric view and vice versa.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	-	-	-	-	-	2	-	2	-	-	2	-	-
2	2	-	-	-	-	-	-	2	-	2	-	-	2	-	-
3	1	-	-	-	-	-	-	2	-	2	-	-	2	-	-
4	1	-	-	-	-	-	-	2	-	2	-	-	2	-	-
5	1	-	-	-	-	-	-	2	-	2	-	-	2	-	-

UNIT I **7 Hours**

FUNDAMENTALS OF ENGINEERING DRAWING

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

UNIT II **9 Hours**

PROJECTION OF POINTS AND LINES

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

UNIT III **9 Hours**

PROJECTION OF PLANES AND SOLIDS

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

UNIT IV **9 Hours**

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

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

UNIT V **11 Hours**

ORTHOGRAPHIC PROJECTIONS AND ISOMETRIC VIEW

Orthographic projections and isometric view of components used in engineering applications.

Total: 45 Hours

Reference(s)

1. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2019.
2. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.
3. K Venugopal, Engineering Drawing and Graphics, Sixth edition, New Age International, 2013.
4. Basant Agarwal, Mechanical drawing, Tata McGraw-Hill Education, 2013.
5. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards - Sp46, 2013.

22HS003 HERITAGE OF TAMILS 1 0 0 1

Course Objectives

- Describe the linguistic diversity in India, highlighting Dravidian languages and their features
- Summarize the evolution of art, highlighting key transitions from rock art to modern sculptures
- Examine the role of sports and games in promoting cultural values and community bonding
- Discuss the education and literacy systems during the Sangam Age and their impact.
- Outline the importance of inscriptions, manuscripts, and the print history of Tamil books in preserving knowledge and culture

Programme Outcomes (POs)

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the concept of language families in India, with a focus on Dravidian languages.
2. Trace the evolution of art from ancient rock art to modern sculptures in Tamil heritage.
3. Identify and differentiate various forms of folk and martial arts in Tamil heritage.
4. Understand the concepts of Flora and Fauna in Tamil culture and literature.
5. Evaluate the contributions of Tamils to the Indian Freedom Struggle.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
3	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-

UNIT I **3 Hours**

UNIT I LANGUAGE AND LITERATURE

Language Families in India - Dravidian Languages - Tamil as aClassical Language- Classical Literature in Tamil- Secular Nature of Sangam Literature- Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II **3 Hours**

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART- SCULPTURE

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III **3 Hours**

UNIT III FOLK AND MARTIAL ARTS

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV **3 Hours**

UNIT IV THINAI CONCEPT OF TAMILS

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V **3 Hours**

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India - Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine - Inscriptions & Manuscripts - Print History of Tamil Books.

Total: 15 Hours

Reference(s)

1. Dr. K. K. Pillay, Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
2. Dr. S. Singaravelu, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies.
4. Dr. M. Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies.
5. Keeladi, Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
6. Dr. K. K. Pillay, Studies in the History of India with Special Reference to Tamil Nadu.

22HS003 தமிழர் மரபு 1 0 0 1

பாடத்திட்டத்தின் நோக்கம்

1. இந்திய மொழிக்குடும்பத்துள் திராவிட மொழிகள் தனித்து இயங்கும் தன்மையை அதன் சிறப்புகள் வழி அறிதல்.
2. தொன்றுதொட்டு தமிழர், கலையில் அடைந்த வளர்ச்சியை இயம்புதல்.
3. சங்ககால தமிழரின் கற்றல் திறத்தை இலக்கியங்கள் வழி ஆராய்தல்.

கற்றலின் விளைவு

1. இந்திய மொழிக்குடும்பத்துள் திராவிட மொழிகள் தனித்து இயங்கும் தன்மையை அதன் சிறப்புகள் வழி அறிதல்.
2. தொன்றுதொட்டு தமிழர், கலையில் அடைந்த வளர்ச்சியை இயம்புதல்.
3. சங்ககால தமிழரின் கற்றல் திறத்தை இலக்கியங்கள் வழி ஆராய்தல்.
4. தமிழ் மொழியின் சிறப்புகளை அதன் படைப்பிலக்கியங்கள் மூலம் அறிந்து கொள்ளுதல்.
5. கற்காலம் தொடங்கி, இக்காலம் வரை சிற்பக்கலை அடைந்த வளர்ச்சியை கண்டுகொள்ளல் .
6. தமிழர் தம் வாழ்வில் எங்கனம் இயற்கையை வணங்கி போற்றினர் என்பதை திணை கோட்பாட்டின் வழி தெளிதல்.
7. இந்திய விடுதலை போரில் தமிழர் ஆற்றிய பங்கினை தெரிந்து கொள்ளுதல்.

அலகு I மொழி மற்றும் இலக்கியம்: **3**

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

3 1 0 4

22MA201 ENGINEERING MATHEMATICS II

Course Objectives

- To impart and analyze the concepts of differential equations to describe in real-world phenomena
- To provide basic understanding on differential equation models and vector field models
- Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of complex functions

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Interpret the concept of differential equations through mathematical modeling and analyze its applications in engineering
2. Formulate the real world problems as second order linear differential equations and give solutions for the same
3. Demonstrate the real-world phenomena with magnitude and direction in the form of vector functions
4. Apply the concept of vector fields and line integrals through mathematical modeling in engineering
5. Determine complex functions and apply them to formulate problems arising in engineering

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

FIRST ORDER LINEAR DIFFERENTIAL EQUATIONS

Formation of differential equations- Solutions of first order linear ODE: Leibnitzs and method of separation of variables - Cooling/Heating of an object - A falling object - Modeling of electric circuits: RL and RC circuits - Modeling of population dynamics: Exponential growth and decay - Logistic growth model

UNIT II **9 Hours**

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS

Methods of solving second order linear ordinary differential equations - Models for linear oscillators: Simple harmonic motion - Mechanical vibrations with and without damping - Electric circuit system: RLC circuits

UNIT III **9 Hours**

VECTOR DIFFERENTIAL CALCULUS

Vector and scalar functions - Fields - Derivative of a vector function and geometrical interpretation - Velocity and acceleration - Gradient and its properties - Tangent and normal vectors - Directional derivative - Divergence of a vector field - Curl of a vector field - Projectile motion

UNIT IV **9 Hours**

VECTOR INTEGRAL CALCULUS

Line integrals of vector point functions - Surface integral of vector point functions - Applications of line and surface integrals - Greens theorem in a plane - Stokes theorem - Gauss divergence theorem

UNIT V **9 Hours**

COMPLEX FUNCTIONS

Basic concepts of Complex numbers Geometrical representation of complex number - Analytic functions and its properties - Construction of Analytic functions: Fluid flow Electric flow - Mapping of complex functions

Total: 45+15= 60 Hours

Reference(s)

1. Richard E. Williamson, Introduction to Differential Equations and Dynamical Systems, McGraw Hill Companies. Inc, 1997
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B. Thomas, Maurice D. Weir and Joel Hass Thomas Calculus, 13/e, Pearson Publishers, 2013
4. Erwin Kreyszig, Advanced Engineering Mathematics Wiley, 10th editi5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017on ,2015
5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017

22PH202 ELECTROMAGNETISM AND MODERN PHYSICS

2 0 2 3

Course Objectives

- Understand the principles and mechanisms of electricity and magnetism
- Infer the classification of electromagnetic waves
- Analyze the theory of relativity and energy bands

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO4. 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.
PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO12. Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change

Course Outcomes (COs)

1. Analyze the mechanisms of Coulomb's law and electric potential in various charge system
2. Analyze the magnetic properties of materials and their effects on external magnetic fields
3. Analyze the classification of electromagnetic waves based on frequency and wavelength
4. Outline the importance of theory of relativity and analyze the wave nature of particles
5. Apply the principles of electron and hole transport to study p-type and n-type semiconductors.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	2	-	-	1	-	-	-
2	3	2	1	2	-	-	-	-	2	-	-	1	-	-	-
3	3	2	2	1	-	-	-	-	2	-	-	1	-	-	-
4	3	2	2	1	-	-	-	-	2	-	-	1	-	-	-
5	3	2	2	1	-	-	-	-	2	-	-	1	-	-	-

UNIT I **6 Hours**

ELECTRICITY

Electric monopoles - Electric field - Electric flux - Electric potential - Electrical energy- Capacitor- Conductors and Insulators - Electric dipole and polarization - Electric current - Voltage sources - Resistance

UNIT II **6 Hours**

MAGNETISM

Sources of magnetism - Monopoles - Magnetic field and force - magnetic field and current distribution - Magnetic dipole - Magnetic potential energy - Inductor - Electric and magnetic field comparison

UNIT III **6 Hours**

ELECTROMAGNETIC WAVES AND LIGHT

Electromagnetism: Basic laws - Electromagnetic energy - radiation. Electromagnetic waves: Origin, nature and spectrum - Visible light. Principle of least time - Geometrical optics-Human eye - Diffraction - Interference - Polarization - LASER

UNIT IV **6 Hours**

MODERN PHYSICS

Special theory of relativity - Simultaneity and time dilation - Length contraction - Relativistic mass variation. Matter waves - De-Broglie hypothesis - Wave nature of particles

UNIT V **6 Hours**

ENERGY BANDS IN SOLIDS

Band theory of solids - Classification of materials - Semiconductors - Direct and indirect semiconductor - Fermi energy - Intrinsic and extrinsic semiconductor - Carrier concentration - Electrical conductivity

5 Hours

EXPERIMENT 1

Analysis a I-V characteristics of a solar cell for domestic applications

5 Hours

EXPERIMENT 2

Determine the carrier concentration of charge carriers in semiconductors for automotive applications

5 Hours

EXPERIMENT 3

Investigate the photonic behavior of laser source for photo copier device

5 Hours

EXPERIMENT 4

Implement the principle of stimulated emission of laser for grain size distribution in sediment samples

5 Hours

EXPERIMENT 5

Assess the variation of refractive index of glass and water for optical communication

5 Hours

EXPERIMENT 6

Evaluate the band gap energy of semiconducting materials for display device applications

Total: 60 Hours

Reference(s)

1. C J Fischer, The energy of Physics Part II: Electricity and Magnetism, Cognella Academic Publishing, 2019
2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017

22CH203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Understand the concept of electrochemistry for determination of electrode potential, pH and applications as energy storage devices
- Outline the chemistry of metal corrosion and analyze the methods of corrosion control
- Understand the role of catalyst in the rate of reaction
- Summarize the variation in properties and reactivity of isotopes.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Apply the electrochemical concepts to determine the electrode potential of a metal
2. Analyze the working of batteries for the energy storage devices
3. Analyze the specific operating conditions under which corrosion occurs and suggest a method to control corrosion
4. Analyze the reaction mechanisms and assess the role of catalyst in a chemical reaction
5. Analyze various types of nuclear transmutation including decay reactions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **6 Hours**

ELECTROCHEMISTRY

Origin of potential - Electromotive force - Electrical double layer - Transport of charge within the cell - Cell description - Prediction of cell potentials

UNIT II **6 Hours**

ENERGY STORING DEVICES

Relation between electrical energy and energy content of a cell - Reversible and irreversible cell - Charging and discharging reactions in a reversible cell - Current challenges in energy storage technologies

UNIT III **6 Hours**

METAL CORROSION AND ITS PREVENTION

Oxidation of metals: Electrochemical origin of corrosion - Electromigration - Electron transfer in the presence and absence of moisture - Galvanic series. Strategies for corrosion control: Galvanic anode and impressed current.

UNIT IV **6 Hours**

CATALYSIS

Energy profile diagram for a chemical reaction - activation energy - role of catalyst - homogeneous and heterogeneous catalysis - types

UNIT V **6 Hours**

NUCLEAR REACTIONS

Radioactive and stable isotopes - Variation in properties between isotopes - Radioactive decay (alpha, beta and gamma) - Half-life period - Nuclear reactions - recent applications of radioactive isotopes.

4 Hours

EXPERIMENT 1

Measure industrial effluent water pH and assess water quality against allowed standards

4 Hours

EXPERIMENT 2

Iron (Fe2) in Bhavani River water: Potentiometric Analysis

4 Hours

EXPERIMENT 3

Construct a Zn-Cu electrochemical cell and validate the output by connecting the LED light

5 Hours

EXPERIMENT 4

Evaluate the corrosion percentage in concrete TMT bars

4 Hours

EXPERIMENT 5

Determination of the percentage of corrosion inhibition in plain-carbon steel using natural inhibitors

4 Hours

EXPERIMENT 6

Electroplating of copper metal on iron vessels for domestic application

5 Hours

EXPERIMENT 7

Determination of acid-catalyzed hydrolysis kinetics in locally sourced fruit extracts

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
2. P.H. Rieger, Electrochemistry, Second Edition (Reprint), Springer, Netherland, 2012
3. E. McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010
4. S. Vairam, Engineering Chemistry, John Wiley & Sons, 2014
5. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th edition, (revised) New Age International Publishers, 2011
6. U. Hanefeld, L. Lefferts, Catalysis: An Integrated Textbook for Students, Wiley- VCH, 2017

22GE002 COMPUTATIONAL PROBLEM SOLVING 3 0 0 3

Course Objectives

- Analyze the algorithm design techniques and development principles in solving the real life problems.
- Illustrate the different ways of organizing and storing the data in computing systems.
- Understand the basic network configuration and setup connections among different device systems.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Analyze a problem and formulate algorithms, pseudocodes and flowcharts.
2. Develop algorithmic solutions to simple computational problems and explore algorithmic approaches to problem solving.
3. Design and apply appropriate data structures for solving computing problems.
4. Compare the various storage devices used in a computer system.
5. Analyze the requirements for a given organizational structure and establish the connection between two or more computers to form a network.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	2	-	-	-	-	-	-	-	-	-	-	-
2	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
3	2	2	2	3	-	-	-	-	-	-	-	-	-	-	-
4	2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
5	2	2	2	2	-	-	-	-	-	-	-	-	-	-	-

UNIT I **6 Hours**

VISUAL PROCESS MODELING

Scenario decomposition - Logical sequencing - Drawing flowchart - Preparation of visual process model.

UNIT II **12 Hours**

ALGORITHMIC DESIGN THINKING

Analysis - Verification - Brute force - Divide and conquer - Greedy - Backtracking.

UNIT III **12 Hours**

DATA ORGANIZATION

Elementary Data Organization - Abstract Data Types - Fundamentals of Linear and Non Linear Data Structures.

UNIT IV **7 Hours**

DATA STORAGE

Flat File and Relational database - Data Read & Write in Local Storage, Server Storage and Cloud storage - Database Query Methods.

UNIT V **8 Hours**

NETWORKING ESSENTIALS

Networking Components and Services - IP Addressing - Configuring and Managing the Campus Network - Network Security - Firewalls.

Total: 45 Hours

Reference(s)

1. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education Asia, 2011.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,2016.
4. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", McGraw Hill, 2015.
5. Behrouz A.Forouzan, "Data Communication and Networking", 5th Edition, Tata McGraw-Hill, 2014.

22GE004 BASICS OF ELECTRONICS ENGINEERING 2 0 2 3

Course Objectives

- To Understand the concept of energy transmission through mechanical, electrical and electromagnetic form.
- To Analyze the use of PN Junction Diode and BJT for signal conditioning.
- To apply the working principle of PN Junction Diode and BJT for the design of basic Digital Logic.
- To analyze the working and characteristics of Special Purpose Semiconductor Electronic Devices.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Understand the need for electrical and electromagnetic signal transmission.
2. Analyze the working principle and characteristics of PN junction diode.
3. Analyze the working principle and characteristics of Bipolar Junction Transistor.
4. Apply the working principle of PN Junction diode and BJT for designing basic Digital Logic functions.
5. Analyze the energy conversion needs and working principle of Special purpose electronic devices.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	-	-	-	-	-	-	-	-	-	-	-
2	3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
3	3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
4	3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
5	3	3	3	1	-	-	-	-	-	-	-	-	-	-	-

UNIT I **6 Hours**

ENERGY TRANSFER AND SIGNALS

Energy Transmission through Mechanical, Electrical and Electromagnetic means, Signal as Energy Transmission, Complexity in signal transmission (Volume of Information, Distance and Time taken), Limitations of Mechanical Energy Transmission, Electrical and Electromagnetic Signal Transmission, Need for Conversion between Electrical and Mechanical Signals.

UNIT II **8 Hours**

SIGNAL CONDITIONING USING DIODE

Need for Vacuum Tubes in the Evolution of Electronics, Overview of Vacuum Tubes, Diode and Triode, Limitations of Vacuum Tubes. Semiconductor Group in Periodic Table, Overview of Semiconductor Materials, Flow of electrical energy through PN Junction Diode, Signal Clipping, Signal Clamping and Signal Multiplication using PN Junction Diode, Limitations of PN Junction Diode.

UNIT III **6 Hours**

SIGNAL CONDITIONING USING TRANSISTOR

Need for controlling electrical signals, Principle of Bipolar Junction Transistor operation, Signal Switching and Amplification using BJT, Limitations of BJT, Principle of Field Effect Transistor operation.

UNIT IV **6 Hours**

LOGIC SYNTHESIS USING DIODE AND TRANSISTORS

Overview of Logic Gates, PN Junction and BJT as electronic switches, Digital Logic Synthesis using Diode and Transistor: Diode Logic, Resistor Transistor Logic, Diode Transistor Logic, Transistor Logic.

UNIT V **4 Hours**

DEVICES FOR SPECIAL REQUIREMENTS

Voltage Regulation using Zener Diode, Variable Capacitance using Varactor Diode, Electrical Energy to Light Energy conversion using Light Emitting Diode, Light to Energy to Electrical Energy conversion using Solar Cell.

6 Hours

EXPERIMENT 1

Implement a morse code generator using basic electronic components and Arduino using wired and wireless methods.

6 Hours

EXPERIMENT 2

Design and construct regulated DC power supply for Mobile phone charger

6 Hours

EXPERIMENT 3

Design and construct an audio amplifier circuit to play the mobile music in a huge speaker

6 Hours

EXPERIMENT 4

Design and construct Switching circuit for the Pump to control over flow and drain condition for overhead tank using PN junction diode.

6 Hours

EXPERIMENT 5

Design and Implement a BJT Amplifier Circuit to amplify audio input signal.

Total: 60 Hours

Reference(s)

1. Thomas L. Floyd, Electronic Devices: Electron Flow Version, Ninth Edition, Prentice Hall, 2012.
2. J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2007.
3. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education 2006.
4. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 2003.
5. Adel S. Sedra & Kenneth C. Smith, Micro Electronic Circuits Theory and Applications, Sixth Edition, Oxford University Press, 2013.
6. Behzad Razavi, Microelectronics, Wiley India Pvt. Ltd.; 2nd edition (2018)

22HS002 STARTUP MANAGEMENT **1 0 2 2**

Course Objectives

- Promote entrepreneurial spirit and motivate to build startups
- Provide insights on markets and the dynamics of buyer behaviour
- Train to develop prototypes and refine them to a viable market offering support in developing marketing strategies and financial outlay enable to scale up the porotypes to commercial market offering
- Support in developing marketing strategies and financial outlay
- Enable to scale up the porotypes to commercial market offering

Programme Outcomes (POs)

PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. 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.

PO11. 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.

Course Outcomes (COs)

1. Generate valid and feasible business ideas
2. Create Business Model Canvas and formulate positioning statement
3. Invent prototypes that fulfills an unmet market need
4. Formulate business strategies and create pitch decks
5. Choose appropriate strategies for commercialization

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	1	2	1	-	1	-	-	-	-
2	-	-	-	-	-	-	2	2	1	1	2	-	-	-	-
3	-	-	-	-	-	-	3	3	1	2	2	-	-	-	-
4	-	-	-	-	-	-	1	3	1	2	2	-	-	-	-
5	-	-	-	-	-	-	2	3	2	2	2	-	-	-	-

UNIT I **3 Hours**

BUSINESS MODELS AND IDEATION

Startups: Introduction, Types of Business Modes for Startups. Ideation: Sources of Ideas, Assessing Ideas, Validating Ideas, Tools for validating ideas, Role of Innovation and Design Thinking

UNIT II **3 Hours**

UNDERSTANDING CUSTOMERS

Buyer Decision Process, Buyer Behaviour, Building Buyer Personas, Segmenting, Targeting and Positioning, Value Proposition (Business Model Canvas), Information Sourcing on Markets, Customer Validation

UNIT III **3 Hours**

DEVELOPING PROTOTYPES

Prototyping: Methods - Paper and Digital, Customer Involvement in Prototyping, Product Design Sprints, Refining Prototypes

UNIT IV **3 Hours**

BUSINESS STRATEGIES AND PITCHING

Design of Marketing Strategies and Campaigns, Go-To-Market Strategy, Financial KPIs Financial Planning and Budgeting, Assessing Funding Alternatives, Pitching, Preparing Pitch Decks

UNIT V **3 Hours**

COMMERCIALIZATION

Implementation: Prototype to Commercialization, Test Markets, Institutional Support, Registration Process, IP Laws and Protection, Legal Requirements, Type of Ownership, Building and Managing Teams, Defining role of investors

1 Hours

EXPERIMENT 1

Analysis of various business sectors

2 Hours

EXPERIMENT 2

Developing a Design Thinking Output Chart

1 Hours

EXPERIMENT 3

Creating Buyer Personas

3 Hours

EXPERIMENT 4

Undertake Market Study to understand market needs and assess market potential

2 Hours

EXPERIMENT 5

Preparation of Business Model Canvas

15 Hours

EXPERIMENT 6
Developing Prototypes

2 Hours

EXPERIMENT 7
Organizing Product Design Sprints

2 Hours

EXPERIMENT 8
Preparation of Business Plans

2 Hours

EXPERIMENT 9
Preparation of Pitch Decks

Total: 45 Hours

Reference(s)

1. Rashmi Bansal, Connect the Dots, Westland and Tranquebar Press, 2012
2. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving, Penguin Random House India, 2020
3. Ronnie Screwvala, Dream with Your Eyes Open: An Entrepreneurial Journey, Rupa Publications, 2015
4. Stephen Carter, The Seed Tree: Money Management and Wealth Building Lessons for Teens, Seed Tree Group, 2021
5. Kotler Philip, Marketing Management, Pearson Education India, 15th Edition
6. Elizabeth Verkey and Jithin Saji Isaac, Intellectual Property, Eastern Book Company, 2nd Edition, 2021

22HS006 TAMILS AND TECHNOLOGY 1 0 0 1

Course Objectives

- Analyse graffiti on potteries as a form of historical and cultural documentation during the Sangam Age.
- Investigate the building materials and the historical context of Hero stones during the Sangam Age by Analysing the details of stage constructions in Silappathikaram and their cultural significance.
- Examine ancient knowledge of oceans and its impact on Tamil society.

Programme Outcomes (POs)

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the significance of the weaving industry during the Sangam Age and its cultural importance.
2. Understand the significance of dams, tanks, ponds, and sluices in the agricultural and irrigation practices of the Chola Period.
3. Explore the architectural designs and structural construction methods used in household materials during the Sangam Age.
4. Explore the art of shipbuilding in ancient Tamil culture and its role in maritime trade and transportation.
5. Trace the development of scientific terminology and vocabulary in Tamil language.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
3	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-

UNIT I **3 Hours**

WEAVING AND CERAMIC TECHNOLOGY

Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW) - Graffiti on Potteries.

UNIT II **3 Hours**

DESIGN AND CONSTRUCTION TECHNOLOGY

Designing and Structural construction House and designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age - Details of Stage Constructions in Silappathikaram -

Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple) - Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period

UNIT III **3 Hours**

MANUFACTURING TECHNOLOGY

Art of Ship Building-Metallurgical studies-Iron industry-Iron smelting,steel-Copper and gold-Coins as source of history-Minting of Coins-Beads making-industries Stone beads -Glass beads-Terracotta beads-Shell beads-bone beats-Archeological evidences-Gem stone types described in Silappathikaram.

UNIT IV **3 Hours**

AGRICULTURE AND IRRIGATION TECHNOLOGY

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry-Wells designed for cattle use- Agriculture and Agro Processing-Knowledge of Sea-Fisheries-Pearl-Conche diving-Ancient Knowledge of Ocean-Knowledge Specific Society.

UNIT V **3 Hours**

SCIENTIFIC TAMIL & TAMIL COMPUTING

Development of Scientific Tamil-Tamil computing-Digitalization of Tamil Books-Development of Tamil Software-Tamil Virtual Academy-Tamil Digital Library-Online Tamil Dictionaries-Sorkuvai Project.

Total: 15 Hours

Reference(s)

1. Dr. K. K. Pillay , Social Life of Tamils, A joint publication of TNTB & ESC and RMRL
2. Dr. S. Singaravelu, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr. S. V. Subatamanian , Dr.K.D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies.
4. Dr. M. Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies
5. Keeladi - Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
6. Dr. K. K. Pillay, Studies in the History of India with Special Reference to Tamil Nadu.
7. Porunai Civilization, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
8. R Balakrishnan. Journey of civilization Indus to Vaigai, RMRL

22HS006 - தமிழரும் தொழில்நுட்பமும் 1 0 0 1

பாடத்திட்டத்தின் நோக்கம்

- சங்க காலத்தில் வரலாறு மற்றும் கலாச்சார ஆவணங்களின் ஒரு வடிவமாக, மட்பாண்டங்கள் மீதான கிராஃபிட்டியை பகுப்பாய்வு செய்தல்.
- சிலப்பதிகாரத்தில் கட்டப்பட்ட மேடை கட்டுமானங்களின் விவரங்களையும் அவற்றின் கலாச்சார முக்கியத்துவத்தையும் பகுப்பாய்வு செய்வதன் மூலம், சங்க காலத்தில் மாவீரர் கற்களின் கட்டுமானப் பொருட்கள் மற்றும் வரலாற்று சூழலை ஆராய்தல்.
- சமுத்திரங்கள் பற்றிய பண்டைய அறிவையும், தமிழ் சமூகத்தில் அதன் தாக்கத்தையும் ஆராய்வது ஆகியவை இப்பாடத்திட்டத்தின் நோக்கம் ஆகும்.

கற்றலின் விளைவு

1. சங்க காலத்தில் நெசவுத் தொழிலின் முக்கியத்துவத்தையும் அதன் கலாச்சார முக்கியத்துவத்தையும் புரிந்து கொள்ளல்.
2. சோழர் கால விவசாய மற்றும் நீர்ப்பாசன நடைமுறைகளில் அணைகள், குளங்கள் மற்றும் மதகுகளின் முக்கியத்துவத்தைப் புரிந்து கொள்ளல்.
3. சங்க காலத்தில் வீட்டுப் பொருட்களில் பயன்படுத்தப்பட்ட கட்டடக்கலை வடிவமைப்புகள் மற்றும் கட்டமைப்பு கட்டுமான முறைகளை ஆராய்தல்.
4. பண்டைய தமிழ் கலாச்சாரத்தில், கப்பல் கட்டும் கலை, கடல் வர்த்தகம் மற்றும் போக்குவரத்தில் அதன் பங்கை ஆராய்தல்.
5. தமிழ் மொழியில் அறிவியல் சொற்களஞ்சியம் மற்றும் சொல்லகராதியின் வளர்ச்சியைக் கண்டறிதல்.

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III <u>உற்பத்தித் தொழில் நுட்பம்</u>: 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV <u>வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்</u>: 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V <u>அறிவியல் தமிழ் மற்றும் கணித்தமிழ்</u>: 3

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும்
   கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22HS009 COCURRICULAR OR EXTRACURRICULAR ACTIVITY - - - NC

Course Objectives

- To develop Interpersonal and Leadership Skills
- To Foster Personal Growth and Time Management
- To enhance Community Engagement and Social Responsibility

Programme Outcomes (POs)

PO8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PO10. 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.

PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Build leadership skills and teamwork capabilities by engaging in group activities through organization and participation of events
2. Demonstrate the technical, creative, and interpersonal skills through active participation in technical events.
3. Exhibit balanced academics with diverse cultural, sports, and literary activities, showcasing improved time management and organizational skills.
4. Enhance the social responsibility and community engagement by participating in outreach and extension activities.
5. Gain practical experience and industry insights through field visits, industrial training, and internships.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	3	3	3	-	2	-	-	-
2	-	-	-	-	-	-	-	3	3	3	-	2	-	-	-
3	-	-	-	-	-	-	-	3	3	2	-	2	-	-	-
4	-	-	-	-	-	-	-	2	2	2	-	2	-	-	-
5	-	-	-	-	-	-	-	3	3	3	-	2	-	-	-

Every student shall be required to undergo a minimum of 40 hours of Co-curricular / Extracurricular activities organized through society chapters, technical and non-technical Club activities during the II semester, failing which he/she shall not be permitted to appear for the VIII Semester examination. Such students are permitted to appear for the Semester End examinations only after completing the requirements. The attendance of the courses / events shall be maintained on the regular basis by the concerned Co-coordinators and made available in the Office of the Controller of Examinations before the commencement of Semester end examinations of Semester II.

The following co-curricular and extra-curricular activities are conducted on a regular basis and is compulsory for all students. The students' performances are assessed on the basis of their participation and organization of events in voluntary services, performance in technical and nontechnical events, games and sports, performance in literary activities, performance in cultural activities and their participation in District/Regional/State/National and International level events.

Co-Curricular activity

Technical events organized through departments, Special labs, Clubs, Society and Chapters etc. includes but not limited to Workshop, Seminar, Conference, Symposium Technical Contest Competition, Field visit, Industrial Training, and Internships.

Extracurricular activity

Non-Technical Events Organized through departments, Special labs, Clubs, Society and Chapters etc. includes but not limited to NSS Camp, NCC Camp, YRC activity, Yoga, Sports and games, Cultural events, Outreach activity and Extension activity.

Total 40 Hours

22AG301 NUMERICAL METHODS AND STATISTICS 3 1 0 4

Course Objectives

- Understand the methods to solve polynomial equations and Implement the ideas of numerical interpolation
- Develop enough confidence to solve differential equations numerically
- Summarize and apply the concepts of statistics in solving engineering problems

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Apply the basic concepts of solving equations and able to identify the derivative and integration of functions.
2. Execute the knowledge of solving various types of ordinary and partial differential equations numerically.
3. Demonstrate the ideas of basics statistics in engineering.
4. Apply the knowledge to testing of hypothesis for small and large samples in engineering problems.
5. Analyze the knowledge of design of experiments and control charts in the field of Engineering.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **10 Hours**

NUMERICAL TECHNIQUES FOR SOLVING EQUATIONS, DIFFERENTIATION AND INTEGRATION

Solution of algebraic and transcendental equations - Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Jacobis method for inverse matrices- Eigenvalues of a matrix by Power method -Interpolation - Lagranges interpolation - Approximation of derivatives using interpolation polynomials- Numerical integration using Simpsons rule

UNIT II **9 Hours**

SOLUTION OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Solution of ordinary differential equation: Fourth order Runge - Kutta method for solving first order equations - Solution of two-dimensional heat equation: Laplaces and Poissons equations- One dimensional heat flow equation- Solution of One dimensional wave equation

UNIT III **7 Hours**

BASIC STATISTICS

Mean-Median-Mode-Variance and Standard deviation -Covariance - Correlation and Regression

UNIT IV **9 Hours**

TESTING OF HYPOTHESIS

Sampling distributions-Estimation of parameters- Statistical hypothesis-large sample tests based on Normal distribution for single mean and difference of means-Tests based on t, Chi-square and F distributions-Chi -square distributions (test for independent and Goodness of fit)

UNIT V **10 Hours**

DESIGN OF EXPERIMENTS AND CONTROL CHARTS

One way and two-way classifications-Completely randomized design-Randomized block design-Latin square design- 2X2 factorial design-Control Charts of Variable and Attributes

Total: 45+15= 60 Hours

Reference(s)

1. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Third Edition, Eastern Economy Edition, 2009
2. Jain M.K, Iyangar S.R.K and Jain R.K Numerical Methods For Scientific and Engineering Computation New Age International (P) Ltd , New Delhi , 2005.
3. William Navidi, Statistics for Engineers and Scientists, 2nd Edition, Tata Mcgraw Hill, 2008.
4. Richard A Johnson, Miller and Feunds Probability and Statistics for Engineers, 8thEdiion, Phi Learning Private Ltd, 2014.
5. Seymour Lipschuts, Introduction to Probability and Statistics, 1st Ediion, McGraw Hill, 2012.

22AG302 SOIL SCIENCE AND ENGINEERING **3 0 2 4**

Course Objectives

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

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem Analysis: Identify, formulate, review research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO4. 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.
PO5 Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Evaluate fundamental geomorphic processes using scientific analysis.
2. Apply engineering techniques for efficient dam and reservoir construction
3. Analyze hydraulic and soil interactions for sustainable infrastructure
4. Investigate soil-water relationships for effective land management.
5. Assess soil strength principles for structural stability in engineering applications

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	1	3	-	-	-	-	-	-	-	-	-	-	-	-
2	2	2	3	2	2	-	1	-	-	-	-	-	-	-	-
3	1	3	1	2	-	-	1	-	-	-	-	-	-	-	-
4	1	3	2	1	-	-	1	-	-	-	-	-	-	-	-
5	1	3	1	2	-	-	-	-	-	-	-	-	-	-	-

UNIT I **10 Hours**

PROPERTIES OF SOILS AND CLASSIFICATION

Introduction of soil mechanics - Soil formation and nature of soils - Phase diagrams - Basic definitions and inter-relationships. Classification of soils based on BIS - Particle size distribution - analysis - Grain size distribution curves - Sedimentation analysis -Stokes law- assumptions-validity- soil structure types- Index Properties of soils - Consistency limits - Relative density. Compaction - Factors affecting compaction - Laboratory & Field Compaction methods

UNIT II **10 Hours**

EFFECTIVE STRESS AND PERMEABILITY

Soil water - Various forms - Static pressure in water - Total, Neutral and Effective stress distribution in soils - Liquefaction & quicksand conditions. Flow of water through soils - Darcys law; Assumptions and validity - Permeability - Coefficient of permeability - Factors affecting permeability - Permeability of stratified deposits of soils - Laboratory tests - Seepage analysis - Quick condition - Velocity potential and stream function - Flow net construction - Piping

UNIT III **9 Hours**

STRESS DISTRIBUTION AND CONSOLIDATION

Boussinesq and Wester Guards theories of stresses due to concentrated loads - Circular, Rectangular load - Strip load - New Marks chart. Consolidation - Fundamental definitions - Spring analogy - Terzaghis one-dimensional consolidation theory - Assumptions, limitations and applications - Pre-consolidation pressureand its determination - Normally, under and over consolidated soils

UNIT IV **8 Hours**

SHEAR STRENGTH OF SOILS

Earth pressure at rest - active pressure - passive pressure - Rankines theory. Shear strength - Factors affecting shear strength of soils- Mohr - Coulomb theory - Measurement of shear strength parameters - Direct shear - Unconfined compression - Triaxial - Drained and un-drained conditions - Vane shear tests

UNIT V **8 Hours**

STABILITY OF SLOPES

Types of slopes - Failure mechanism of slopes - Total and effective stress analysis - Finite slopes - Stability analysis for purely cohesive and c-phi soils - Method of slices - Friction circle method - Taylors Stability number. Stability of earthen embankments, -Bearing Capacity of soil - Testing &Improving Bearing Capacity of soil

2 Hours

EXPERIMENT 1

Determination of water content of soil and specific gravity of soil

4 Hours

EXPERIMENT 2

Determination of Field Density by Core cutter and Sand Replacement methods

4 Hours

EXPERIMENT 3

Mechanical analysis of Soil Sieving

4 Hours

EXPERIMENT 4
Hydrometer analysis for Grain Size Distribution

4 Hours

EXPERIMENT 5
Determination of Atterbergs Limits of Soil Consistency

4 Hours

EXPERIMENT 6
Determination of Hydraulic Conductivity by Constant Permeameter, Variable Head Permeameter

4 Hours

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

4 Hours

EXPERIMENT 8
Direct Shear Test and Vane Shear Test of soils

Total: 45+30=75 Hours

Reference(s)

1. Punmia B C, Jain A K and Jain A K. 2005. Soil Mechanics and Foundations. Laxmi Publications (P) Ltd. New Delhi.
2. Ranjan Gopal and Rao A S R. 1993. Basic and Applied Soil Mechanics. Welley Easters Ltd., New Delhi.
3. Singh Alam. 1994. Soil Engineering Vol. I. CBS Publishers and Distributions, Delhi.

22AG303 ENGINEERING THERMODYNAMICS 3 1 0 4

Course Objectives

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

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. 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.

PSO1. Model, design and analyze agricultural machineries and implements to increase yields, improve land use and conserve conserve agricultural inputs

PSO2. To improvise better ways to minimize the crop loss from field damage during harvesting, sorting, processing and packaging

Course Outcomes (COs)

1. Utilize fundamental thermodynamic concepts and the zeroth law to analyze thermal equilibrium in real-world systems.
2. Apply the first law of thermodynamics to evaluate energy transfer in closed and open systems.
3. Evaluate thermodynamic cycles using the second law to determine efficiency and performance.
4. Examine the thermodynamic properties of pure substances and phase change processes.
5. Evaluate the performance of heat engines and gas mixtures based on air standard cycles

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
2	3	3	-	-	-	-	1	-	-	-	-	-	2	3	-
3	3	3	-	-	-	-	2	-	-	-	-	-	-	3	-
4	3	3	-	-	1	-	2	-	-	-	-	-	2	3	-
5	3	3	2	1	1	2	2	-	-	-	-	-	2	3	-

UNIT I **8 Hours**

INTRODUCTION AND ZEROTH LAW OF THERMODYNAMICS

Macroscopic and Microscopic approaches, energy, heat, work. Thermodynamic system - Types, properties, functions, states, processes and cycle. Zeroth law of thermodynamics - temperature scale, perfect gas scale.

UNIT II **8 Hours**

FIRST LAW OF THERMODYNAMICS

First law of thermodynamics, Application of first law - Closed systems and Open systems, Thermodynamic processes in closed systems, Steady state flow processes in open systems.

UNIT III **9 Hours**

SECOND LAW OF THERMODYNAMICS

Limitations of first law of thermodynamics, Second law of thermodynamics - Kelvin - Planck and Clausius statements, Reversible and irreversible processes, Carnot theorem, Carnot engine, Clausius inequality, Entropy, Availability and irreversibility. Heat Engine, heat pump and refrigerator.

UNIT IV **10 Hours**

PROPERTIES OF PURE SUBSTANCES

Thermodynamic properties of fluids. Pure substance - Phases - Phase change processes, Steam tables and Property diagrams - (P-V), (P-T), (T-V), (T-S) and (h-s) diagrams. Ideal gas equation, Van derWaals equation and compressibility chart.

UNIT V **10 Hours**

GAS MIXTURES AND GAS POWER CYCLES

Thermodynamics and properties of ideal gas mixture and perfect gas mixture - Daltons law of partial pressure, Amagats law. Psychrometric properties and processes - Psychrometric chart. Air standard cycles Otto, Diesel and Dual cycles- mean effective pressure and air standard efficiency.

Total: 45+15=60 Hours

Reference(s)

1. Y. Cengel and Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2019.
2. P.K. Nag, Engineering Thermodynamics,Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2018.
3. J.P.Holman, Thermodynamics, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2016.

4. R.K. Rajput, Engineering Thermodynamics, Laxmi Publications Pvt.Ltd., New Delhi, 2017.
5. Gordon J. Van Wylen, Richard E. Sonntag, Fundamentals of Classical Thermodynamics, December 31st 1978, John Wiley & Sons.

22AG304 FLUID MECHANICS AND MACHINERY 3 0 2 4

Course Objectives

- To impart knowledge on the fluid properties and fluid statics principles
- To introduce the basic concept of fluid kinematics and dynamics.
- To calculate the rate of flow and energy losses in flow through pipes and open channels.
- To emphasize the concepts of boundary layer theory and the importance of dimensional analysis
- To impart the knowledge of pumps and turbines

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO4. 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.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PSO2. To improvise better ways to minimize the crop loss from field damage during harvesting, sorting, processing and packaging

Course Outcomes (COs)

1. Examine the fundamental properties of fluids and implement pressure measurement techniques in fluid statics.
2. Evaluate the principles of fluid kinematics and dynamics in hydraulic experiments.
3. Apply the concept of the boundary layer, Dimensional analysis, and Modal analysis to the fluid structures
4. Evaluate model performance using dimensional analysis and similitude principles.
5. Determine the efficiency and performance of pumps and turbines for effective operation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	-	2	-	-	-	-	2	-	-	-	-	3	-
2	3	3	-	2	-	-	-	-	2	-	-	-	-	3	-
3	3	2	-	2	-	-	-	-	2	-	-	-	-	3	-
4	2	2	-	2	1	-	-	-	2	-	-	-	-	3	-
5	2	2	-	2	-	-	-	-	2	-	-	-	-	3	-

UNIT I **8 Hours**

FLUID PROPERTIES AND FLUID STATICS

Concept of Continuum - Properties of Fluid - Classification of fluids -Types of fluid flow - Streamline,Streamlines, and path line. Pascals Law and Hydrostatic Law, Pressure and its variation in a static Fluid, Measurement of fluid pressure- Manometers- Buoyancy and meta-Centre-Stability analysis and applications.

UNIT II **8 Hours**

FLUID KINEMATICS AND DYNAMICS

Continuity equation-Velocity Potential and Stream function, Bernoullis equation, and its applications-Impulse-Momentum principle-Impact of Jet-Velocity triangle.

UNIT III **9 Hours**

FLOW THROUGH PIPES AND CHANNELS

Laminar and turbulent flows in circular pipes-Major and Minor losses in pipes, Darcy-Weisbach equation, Hagen-Poiseuille equation- Multi-reservoir problems, pipe network design, Types of open Channel flows - Measurement of discharge in open channels: Notches - Most economical channel section.

UNIT IV **10 Hours**

DIMENSIONAL ANALYSIS AND MODEL TESTING

Buckinghams pi-theorem and Application of theorem in fluid flow Reynolds, Froude, and Mach number and their applications in model testing Boundary layer thickness, Momentum integral equation, Drag and lift, Separation of the boundary layer, and Methods of preventing the boundary layer separation.

UNIT V **10 Hours**

HYDRAULIC MACHINES

Centrifugal pumps - Work done - Head developed - Pump output and Efficiencies - priming - minimum starting speed - performance of multistage pumps - Cavitation - methods of prevention - Pump characteristics. Classification of hydraulic turbines - Pelton wheel - Francis turbine - Kaplan and turbines - Specific speed-Performance characteristics - Selection of turbines- Turbine efficiencies

6 Hours

EXPERIMENT 1

Find the coefficient of discharge by suitable device that is most accurate to measure the fuel and air distribution in the carburetor of an IC engine in a two wheeler Also, in Pasteurization and Sterilization process. Discuss the effects of the Reynolds number and friction factor in relation to the rate of flow

3 Hours

EXPERIMENT 2

Analyze the friction factor of various pipes in a distribution of a water supply for domestic applications

3 Hours

EXPERIMENT 3

Determine the coefficient of discharge by suitable device used to monitor and control the flow of water and chemicals in water treatment plants

3 Hours

EXPERIMENT 4

Analyze the Lift and drag force of an aerofoil design used in a windmill for power generation

3 Hours

EXPERIMENT 5

Conduct the performance test of a suitable turbine that is used to extract energy from waterfalls whose water drops down from a height of about 500 m to generate power in Hydropower station

6 Hours

EXPERIMENT 6

Conduct the test from which electricity is to be generated has its reservoir fully filled up during the rainy season and the level drops down during summer. A turbine has to be put up such that it can accommodate both cases in a hydropower station

6 Hours

EXPERIMENT 7

Determine the efficiency of a pump to pump water to a very high elevation, say >300 ft, and high viscous fluid used for an irrigation and Chocolate Industry

Total: 45+30= 75 Hours

Reference(s)

1. Yunus A. Cengel, and John M. Cimbala, Fluid Mechanics, Third edition, Mc Graw Hill Education (India) Pvt. Ltd, 2014.
2. Dr R.K. Bansal , A text book of Fluid Mechanics and Hydraulic Machines, Tenth Edition, Laxmi Publications, New Delhi, 2018.
3. Frank .M. White, Fluid Mechanics, McGraw Hill Publishing Company Ltd, New Delhi, 8th Edition. 2017
4. R.C. Hibbler, Fluid Mechanics, Pearson, First edition, 2017.
5. S.K. Som and G. Biswas, Introduction to Fluid Machines, 3rd Edition, McGraw-Hill Education, 2017.
6. https://nptel.ac.in/courses/112105183

22AG305 SURVEYING AND LEVELLING 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem Analysis: Identify, formulate, review research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO4. 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.
PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Analyze the principles of chain surveying to improve accuracy in distance measurement.
2. Structure various leveling and compass surveying methods for precise elevation and direction assessment
3. Interpret the application of theodolite surveying for accurate distance and angle measurement.
4. Evaluate the effectiveness of contour mapping and plane tabling techniques in topographical surveys
5. Develop efficient solutions for earthwork computation and integrate modern surveying technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	3	-	-	-	-	-	-	-	-	-	-	-	-
2	2	1	3	2	2	-	-	-	-	-	-	-	-	-	-
3	1	3	1	2	-	-	1	-	-	-	-	-	-	-	-
4	1	3	2	2	-	-	1	-	-	-	-	-	-	-	-
5	1	3	1	1	-	-	1	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

PRINCIPLES OF SURVEYING

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

UNIT II **9 Hours**

LEVELLING AND COMPASS TRAVERSING

Levelling-Principles and theory of Levelling -Datum -Bench Marks-Temporary and Permanent Adjustments- Methods of Levelling-Theory of simple, compound, cross sectional and reciprocal levelling.Basic terminologies of Compass traversing- Prismatic and Surveyors Compass - Checking the accuracy of traverse - Errors and mistakes in Compass survey.

UNIT III **9 Hours**

THEODOLITE AND TACHEOMETRIC SURVEYING

Theodolite-Types-Temporary and Permanent adjustments-Horizontal and vertical angle measurements-Heights and distances-Reduced levels -Tacheometric surveying - Tangential and Stadia Tacheometry - Subtense bar method - Stadia constants -Anallactic lens-Tacheometric contouring.

UNIT IV **9 Hours**

CONTOURING AND PLANE TABLE SURVEYING

Contour -Contouring -Characteristics of contours-Methods of contouring -Contour gradient -Uses of contour plan and map. Plane tabling -instruments and accessories -Radiation, Traversing, Orientation-Intersection and Resection.

UNIT V **9 Hours**

MODERN SURVEYING AND COMPUTATION OF AREA

Introduction-Total Station-Global Positioning System (GPS)-GNSS. Formulate for calculation of cross-sectional area- calculation of volume-Area computation, Mid-Ordinate rule- Average ordinate rule-Trapezoidal rules-Simpson rule and Coordinate method

FOR FURTHER READING

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

4 Hours

EXPERIMENT 1

Measure the area of BIT girls hostel parking and prepare the map by chain surveying

4 Hours

EXPERIMENT 2

Measure the horizontal angle of the given coordinates in the BIT agriculture land using compass

6 Hours

EXPERIMENT 3

Measure the area of the BIT play ground and prepare the map by radiation and intersection method of plane table surveying

4 Hours

EXPERIMENT 4

Measurement of horizontal angle of the given coordinates in the BIT agriculture field using theodolite

4 Hours

EXPERIMENT 5

Measurement of BIT main gate car parking area using total station and GPS

4 Hours

EXPERIMENT 6

Measure the elevation difference between BIT play ground to BIT main gate car parking by leveling surveying

4 Hours

EXPERIMENT 7

Analyze and compute the irregular area of the BIT agriculture land by chain surveying

Total: 45+30= 75 Hours

Reference(s)

1. Punmia. B.C Surveying (Vol- I & Vol-II) Laxmi publications, New Delhi. 1991.
2. Kanetkar, T.P. & Kulkarni, S.V., Surveying & leveling Part I, A.V.G. Prakashan, Poona 1984.
3. Basak. V.N. 1994.Surveying and Levelling, Tata McGraw hill publications, New Delhi
4. A.M. Michael and T.P. Ojha Agricultural Engineering (Vol-II), New Delhi

22HS004 HUMAN VALUES AND ETHICS 2 0 0 2

Course Objectives

- Understand the concept of good values and comprehend the importance of value-based living.
- Recognize the culture of peace through education.
- Identify and apply the practices for value development and clarification.

Programme Outcomes (POs)

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Apply the importance of human values and ethics in life.
2. Analyze the importance of harmonious living in a diverse society.
3. Analyze the sensitivity to the crying needs of society such as ungodliness, corruption, poverty, and suffering, and play a vital role in eradicating them.
4. Evaluate intellectually mature, morally upright, ethically correct, and spiritually inspired decisions.
5. Create a correct balance between professional excellence and social commitment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	3	2	1	-	-	-	-	-
2	-	-	-	-	-	-	-	3	2	1	-	-	-	-	-
3	-	-	-	-	-	-	-	3	2	1	-	-	-	-	-
4	-	-	-	-	-	-	-	3	2	1	-	-	-	-	-
5	-	-	-	-	-	-	-	3	2	1	-	-	-	-	-

UNIT I **6 Hours**

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

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

UNIT II **6 Hours**

EMBRACING THE COMMON ETIQUETTE

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

UNIT III **6 Hours**

CONTINUOUS HAPPINESS AND PROSPERITY

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

UNIT IV **6 Hours**

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

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

UNIT V **6 Hours**

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

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

Total: 30 Hours

Reference(s)

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

22HS005 SOFT SKILLS AND EFFECTIVE COMMUNICATION

0 0 2 1

Course Objectives

- Communicate proficiently in formal discussions at the workplace.
- Describe experiences and events, and briefly give reasons and explanations for opinions and plans.
- Interact with a degree of fluency and spontaneity that results in efficacious communication
- Convey agreement and disagreement in a polite but firm manner
- Communicate with coherence and imagination in both written and spoken formats

Programme Outcomes (POs)

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Enhance confidence in expressing thoughts in grammatically proper language and etiquette in waiting for the opportunity to provide input
2. Effectively communicate in English on formal occasions and proficiency in the use of link words and other discourse markers
3. Provide constructive feedback and file logical complaints
4. Analyse the understanding of oral and written communication in real-world situations.
5. Apply the improved spelling and punctuation in writing and heightened understanding of tone, pitch and stress in oral formats.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
3	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-

UNIT I **10 Hours**

SELF-EXPRESSION

Group discussion/ Peer discussion - Communicating decisions and opinions - Tone, Pitch, Stress - Agreeing, Disagreeing, Suggesting, Speculating - Comparing and Contrasting - Comparatives and SuperlativesDiscourse markers – Interjections Decision making - Synthesis - Higher order thinking - Group discussion/Peer discussion - Effective Communication Types of communication - Written vs Spoken - Contractions Intonation Stress Active voice - Question tags - Confidence and body language Guided writing- Outlining Main Points - Group discussion/Peer discussion - Avoiding common errors Reduction of MTI - Common errors - Barriers to communication Accent

UNIT II **10 Hours**

CREATIVE EXPRESSION

JAM, Debate, Review writing, Social media posts Synonyms - Antonyms Cloze test Phrasal verbs Spotting errors Collocation - Commonly mispronounced

UNIT III **10 Hours**

FORMAL EXPRESSION

Writing: Giving written feedback, Review writing, and Letter of complaint. Speaking: Giving constructive feedback and offering suggestions, asking for inputs, commenting politely on appropriate phrases - Giving written feedback, Review writing, and Letter of complaint. Critical reasoning - Modal verbs - Polite ways to express negatives

Total: 30 Hours

Reference(s)

1. Word Power Made Easy by Norman Lewis, W. R. Goyal Pub. & Distributors, 2009.
2. Sasikumar, V, et al., A Course in Listening & Speaking Foundation Books, 2005.
3. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
4. Prasad, Hari Mohan. A Handbook of Spotting Errors, Mcgraw Hill Education, 2010.
5. Personality Development & Soft Skills, Barun K. Mitra, Oxford University Press, 2012
6. Business English by Ken Taylor, Orient Blackswan, 2011

22AG401 CROP PRODUCTION TECHNOLOGY 3 0 2 4

Course Objectives

- To study about the basic principles of crop production activities
- To learn the cultivation practices of various field crops and horticulture crops for increasing the food production
- To impart basic knowledge of insects, pests, and diseases and their associated crop losses.
- To study various methods of plant protection to get more yield in agricultural crops

Programme Outcomes (POs)

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Execute the concepts and principles of crop growth, climate influence, soil fertility and tillage for increase the crop productivity
2. Assess the various cultivation practices for major cereals, millets, minor millets and pulse crops, major oil seeds, cotton and sugarcane
3. Find the various cultivation practices for raising different horticultural crops such as fruits, vegetables and flower crops
4. Find the new techniques for cultivate horticultural crops, through different planting methods
5. Assess different management practices to control the groups of insects and diseases

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	1	-	-	-	-	2	-	1	-	-	3	1	-	-
2	-	3	1	-	1	-	-	-	1	-	-	2	2	-	-

3	-	-	1	-	-	-	-	-	-	-	-	1	2	-	-
4	-	1	3	-	-	-	-	-	-	-	-	-	1	-	2
5	-	1	3	-	-	-	-	-	-	-	-	-	1	-	1

UNIT I **9 Hours**

PRINCIPLES OF AGRONOMY

Introduction and scope of agronomy - Classification of crops - Effect of different weather parameters on crop growth and development - Principles of tillage - tilth and its characteristics - Crop seasons - Methods - time and depth of sowing of major field crops - Methods and time of application of manures and fertilizers - Organic farming -Sustainable agriculture - Soil water plant relationship - crop coefficients - water requirement of crops and critical stages for irrigation - weeds and their control - crop rotation - cropping systems - Relay cropping and mixed cropping

UNIT II **9 Hours**

AGRONOMY OF FIELD CROPS

Package of practices for important field crops - rice - maize - sorghum - finger millet and small millets - Pulses -red gram - black gram - green gram - soybean - groundnut - gingelly and sunflower - cotton - sugarcane

UNIT III **9 Hours**

FUNDAMENTALS OF HORTICULTURE

Scope of horticulture - Soil and climatic requirements for fruits - vegetables and floriculture crops – improved varieties - Criteria for site selection - layout and planting methods - nursery raising - commercial varieties - hybrids - sowing and planting times and methods - seed rate and seed treatment for vegetable crops

UNIT IV **9 Hours**

PLANTING TECHNIQUES OF HORTICULTURAL CROPS

Macro and micro-propagation methods - plant growing structures - pruning and training - water requirements and critical stages - fertilizer application - fertigation - irrigation methods - Garden tools - management of orchard - seed production technique

UNIT V **9 Hours**

PLANT PROTECTION MEASURES

Group of insects - Diseases and weeds - Methods of control - Cultural - Physical - Chemical and Biological – Pest management in major crops - Organic way of plant protection

4 Hours

EXPERIMENT 1

Designing of agricultural farm by using Auto CAD to assess crop production requirements

4 Hours

EXPERIMENT 2

Analysing the climatic factors on crop growth with meteorological instruments

4 Hours

EXPERIMENT 3

Implementing methods/application of sowing, fertilizers, irrigation, cropping systems and weed control in various farming

4 Hours

EXPERIMENT 4

Identifying the damage symptoms of pests in crops and learning on their management practices

4 Hours

EXPERIMENT 5

Practicing cultivation operations of major cereal crops, oil seed and sugar crops

4 Hours

EXPERIMENT 6

Practicing cultivation of vegetables, fruit crops, commercial flower crops, plantation crops and lawn

6 Hours

EXPERIMENT 7

Practicing airlayering technique in guava, citrus and approach grafting in mango, sapota

Total: 45+30= 75 Hours

Reference(s)

1. SP. Palaniappan, and S. Sivaraman. 1998. Cropping systems in the tropics- Principles and Management, New Age international publishers, New Delhi, (2nd edition), 1998
2. P.Balasubramain and SP. Palniappan. 2001. Principles and Practices of Agronomy, Agrobios publishers, Ludhiana
3. T. Yellamanda Reddy and G.H. Sankara Reddi. 2014. Principles of Agronomy, Kalyani publishers, Ludhiana
4. B.Chandrasekaran, B., K. Annadurai and E. Somasundaram. 2007. A Text book of Agronomy, Scientific publishers, Jodhpur.
5. N. Dhandapani and S. Uthamasamy. 2000. Integrated pest Management. TNAU Publications, Coimbatore.p.181.

22AG402 HEAT AND MASS TRANSFER 3 0 2 4

Course Objectives

- To familiarize heat transfer mechanisms by conduction
- To expose the mechanisms of free and forced convection
- To develop the shape factor algebra for black body radiation and grey body radiation
- To demonstrate the phase change heat transfer and the performance of heat exchanging devices
- To infer insights about diffusive mass transfer

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO3: Design solutions for complex engineering problems and design system components or processes thameet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Apply the heat conduction equation to compute the rate of heat transfer in one and two - dimensional systems and composite systems
2. Apply the principles of convection phenomena to determine the heat transfer rate in free and forced convection
3. Analyse the heat transfer rate in radiation and compare the thermal performance of heat exchangers using LMTD or NTU approach
4. Execute the principles of mass transfer in diffusive mass transfer applications
5. Evaluate types of convective mass transfer processes for selected applications in food and bioprocessing

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1	-	2	-	-	-	-	-	-	3	-
2	2	3	2	2	1	-	2	-	-	-	-	-	-	3	-
3	3	3	2	2	-	-	2	-	-	-	-	-	-	3	-
4	2	3	2	2	-	-	2	-	-	-	-	-	-	3	-
5	2	3	2	2	-	-	2	-	-	-	-	-	-	3	-

UNIT I **8 Hours**

CONDUCTION

Introduction - Steady State Conduction in one and two -dimensional systems - Composite systems - Extended surfaces

UNIT II **8 Hours**

CONVECTION

Basic concepts - Heat transfer coefficients - Boundary layers - Forced convection - External and Internal flows -correlations - Natural convection

UNIT III **11 Hours**

RADIATION

Basic laws of radiation - Black body radiation - Grey body radiation - Shape factor algebra - Electrical analogy - Radiation shields.

UNIT IV **10 Hours**

PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS

Boiling: Modes- correlations. Condensation: Nusselt theory, correlations. Heat exchangers: heat exchangers analysis, LMTD and Effectiveness- NTU method

UNIT V **8 Hours**

MASS TRANSFER

Diffusion mass transfer - Ficks law of diffusion, Steady state molecular diffusion. Convective mass transfer- correlations – Application

4 Hours

EXPERIMENT 1

Measure the thermal conductivity of the metal bar

4 Hours

EXPERIMENT 2

Determine the transient heat exchange efficiency of the slab

4 Hours

EXPERIMENT 3

Estimate the heat transfer from a cylinder losing heat to the environment

4 Hours

EXPERIMENT 4

Analyze the heat transfer by blowing air over the pipe

4 Hours

EXPERIMENT 5

Measure the temperature of the surface without contact

4 Hours

EXPERIMENT 6

Analyze the parameters required to enhance or promote surface condensation

4 Hours

EXPERIMENT 7

Determine heat transfer in heating systems during the exchange of heat

2 Hours

EXPERIMENT 8

Determine the surface adsorption efficiency of activated charcoal for its use in purifiers

Total: 45+30=75 Hours

Reference(s)

1. Yunus A.Cengel, Heat and Mass Transfer: Fundamentals and Application, Tata McGraw Hill publishing Company private limited, New Delhi, 6th edition, 2020
2. J. P. Holman, Heat Transfer, Tata McGraw Hill publishing Company private limited, New Delhi, 10th edition, 2010
3. Dutta, B.K., Heat transfer: principles and applications. 2nd Edition, PHI Learning Pvt. Ltd. 2023
4. Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt, Principles of Heat and Mass Transfer, ISBN: 978-1-119-38291-1 October 2017
5. R. K. Rajput, Heat and Mass Transfer, S Chand and Company, New Delhi, 2018
6. Robert E. Treybal, Mass transfer operations. McGraw Hill Book Company, Inc., 3rd edition, 2017

22AG403 STRENGTH OF MATERIALS 2 1 2 4

Course Objectives

- To provide knowledge about stress elements subjected to axial and thermal loads
- To familiarize about two-dimensional stress systems and theories of failure
- To construct shear force and bending moment diagrams and evaluate the bending stress in beams under transverse loading
- To impart knowledge on finding slope and deflection of beams and buckling of columns for different boundary conditions
- To enable computation of stresses on shafts and helical springs based on the theory of torsion

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO10: 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.
PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

Course Outcomes (COs)

1. Find the stress distribution and strains in regular and composite structures subjected to axial loads.
2. Evaluate the compound stresses in two dimensional systems and thin cylinders
3. Assess the shear force, bending moment and bending stresses in beams under transverse loading
4. Evaluate the slope and deflection of beams and buckling loads of columns under different boundary conditions
5. Apply torsion equation in design of circular shafts and helical springs

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	-	2	-	-	-	2	-	3	3	-	-
2	3	3	2	2	-	2	-	-	-	2	-	3	3	-	-
3	3	3	2	2	-	2	-	-	-	2	-	3	3	-	-

4	3	3	2	-	-	2	-	-	-	2	-	3	3	-	-
5	3	3	2	2	-	2	-	-	-	2	-	3	3	-	-

UNIT I **6 Hours**

SIMPLE STRESS AND STRAIN

Mechanical properties of Materials - Stress-strain curve -Factor of safety - Strain Energy and Impact Loading - Stepped and Composite bars - Axial Stresses - Thermal Stress and Volumetric Stresses - Elastic constants and their relationship.

UNIT II **6 Hours**

COMPOUND STRESSES AND THIN CYLINDER

State of stresses at a point - 2D Stress System - Plane Stress Condition - Mohr circle - Thin Cylinders - Stresses - Strain - Maximum Shear stress - Changes in dimensions and volume - Theories of Failure - Significance and Graphical Representations

UNIT III **6 Hours**

SHEAR FORCE, BENDING MOMENT AND STRESSES IN BEAMS

Beams - Types of supports - loads and beams - Shear force and Bending Moment in Cantilever - simply supported and overhanging beams - Point of contra flexure - Theory of Simple Bending, Section modulus - Bending stress and stress variation along the length and section of the beam.

UNIT IV **6 Hours**

DEFLECTION OF BEAMS AND COLUMNS

Slope and Deflection of cantilever and simply supported beams by Double integration method and Macaulay method - Theory of Columns - Slenderness ratio - End Conditions - Equivalent length - Euler and Rankine formulae.

UNIT V **6 Hours**

TORSION IN SHAFT AND HELICAL SPRING

Theory of Torsion - Stresses and Deformations in Solid and Hollow Circular Shafts - Combined bending moment and torsion of shafts - Power transmitted to shaft - Shaft in series and parallel - Close coiled helical spring - Stresses - deflection - Maximum shear stress in spring section including Wahl Factor - springs in series and parallel.

6 Hours

EXPERIMENT 1

Assess the hardness of material to be used as brake shoe in bicycles to give long life with minimum wear

3 Hours

EXPERIMENT 2

Select a material to be used as brake cable in bicycle such that the material is able to withstand axial tensile loading and identify the mode of failure

3 Hours

EXPERIMENT 3

Assess the suitability of material as bicycle handle to withstand bending load using deflection beam apparatus

3 Hours

EXPERIMENT 4
Select a material to be used as bicycle fork such that the material is able to withstand axial compressive loading and identify the mode of failure.

3 Hours

EXPERIMENT 5
Assess the suitability of material for fabricating LPG gas cylinders to withstand internal gas pressure using thin cylinder test setup

3 Hours

EXPERIMENT 6
Assess the suitability of material as nail for wooden furniture fabrication withstanding impact loading of hammer

6 Hours

EXPERIMENT 7
Assess the suitability of material as
a) compression spring for bicycle seat and
b) tensile spring for bicycle stand to withstand

3 Hours

EXPERIMENT 8
Select a material to be used as bicycle wheel shaft such that the material is able to withstand torsion loading

Total: 30+15+30=75 Hours

Reference(s)

1. S.S.Rattan, Strength of Materials, McGraw Hill Education (India) Private Limited, Chennai, Third Edition, 2017
2. F. P. Beer and R. Johnston, McGraw Hill Education India Private Limited, Seventh edition, 2017
3. S.S.Bhavikatti, Strength of Materials, Vikas Publishing House, New Delhi, Fourth edition, 2013
4. Egor P. Popov, Engineering Mechanics of Solids, Pearson India Education Services Pvt Ltd, New Delhi, 2015
5. William Nash and Nilanjan Malik, Strength of Materials (Schaum"s Outline Series), McGraw Hill Education, Fourth Edition, 2017

22AG404 THEORY OF MACHINES 3 0 2 4

Course Objectives

- To acquire knowledge about the major types of physical mechanisms and identify the mode of failure based on the velocity and acceleration of axial compressive loading
- To perform force analysis and balancing of reciprocating engines
- To understand the function of flywheel and to determine basic parameters of flywheel
- To determine gear ratio for simple, compound, reverted and epicyclic gear train.

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PSO2. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO3. Model, design and analyze agricultural machineries and implements to increase yields, improve land use and conserve conserve agricultural inputs

Course Outcomes (COs)

1. Assess the characteristics of a given planar mechanism
2. Compare vector mechanics principles to construct velocity and acceleration diagram of planar mechanisms
3. Find the static and dynamic forces acting on the components of a reciprocating engine
4. Justify the concept of balancing of masses in rotating shafts and explain the effect of vibration
5. Compare speed and torque ratio of major gear trains

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	1	-	-	-	-	-	-	-	-	2	-	-
2	3	3	2	-	2	-	-	-	-	-	-	-	2	-	-
3	3	3	2	-	2	-	-	-	-	-	-	-	2	-	1
4	3	3	2	1	-	-	-	-	-	-	-	-	1	2	-
5	3	3	3	-	2	-	-	-	-	-	-	-	2	1	-

UNIT I **9 Hours**

BASICS OF MECHANISMS

Basic concepts of mechanisms: link, joint, pair, chain, mechanism, machine and structure, degree of freedom, mobility of mechanism - Kutzbach criterion, Grashofs law - Inversions of mechanisms: Four bar and slider crank: Mechanical advantage, Transmission angle, Description of some common mechanisms: Straight line generators, dwell mechanisms, ratchets and escapements, universal Joint-Geneva mechanism

UNIT II **9 Hours**

KINEMATICS OF MECHANISMS

Vector representation of Displacement, velocity and acceleration - Graphical method of velocity (relative velocity method) and acceleration diagrams for simple mechanisms - Coriolis component of acceleration

UNIT III **9 Hours**

KINETICS OF MECHANISMS

Static force analysis: Applied and constraint forces, Free body diagrams, Static equilibrium conditions: Two,

three and four members - Static force analysis of simple mechanisms - The principle of superposition Dynamic force analysis: Inertia force and Inertia torque, D Alemberts principle, Dynamic Analysis in Four bar mechanism

UNIT IV **9 Hours**

BALANCING AND VIBRATION

Balancing of Single Rotating mass by a single mass rotating in the same plane and two masses rotating in different planes - Several masses rotating in the same plane and different planes; Introduction to vibration - Types of vibration, Longitudinal, Transverse and torsional-free, forced and damped vibrations.

UNIT V **9 Hours**

GEARS AND GEAR TRAINS

Law of toothed gearing - Involutes and cycloidal tooth profiles - Spur gear terminology and definitions Gear tooth action Interference and undercutting - Problems Helical, bevel, worm, rack and pinion gears - Strain wave(harmonic) gear - Gear trains: Introduction to gear correction, gear trains - Speed ratio, train value, - Types of gear trains: Parallel axis gear trains, Epicyclic gear trains - Determination of gear speeds and torque using tabular method.

4 Hours

EXPERIMENT 1

Identify the velocity and acceleration of a input /output link in a Steering mechanism used in Sedan Car using CAD Software

4 Hours

EXPERIMENT 2

Analyse the cam profile for the four stroke internal combustion engine in a motor cycle

4 Hours

EXPERIMENT 3

Analyze the type of gear train used in automobile power transmission device in a car

4 Hours

EXPERIMENT 4
Ensure the Balancing of rotating components in a hydraulic turbine to ensure efficient energy conversion.

6 Hours

EXPERIMENT 5
Identify the performance of the Equipment which help maintain the stability and orientation in the ships, and submarines

4 Hours

EXPERIMENT 6
Determine the critical speeds of a centrifugal pump used for irrigation applications

4 Hours

EXPERIMENT 7
Perform the analysis of the natural frequency of the shock absorbers in a motorcycle vehicles

Total: 45+30=75 Hours

Reference(s)

1. John J Uichker and Joesph E. Shigley, Theory of Machines and Mechanism, oxford university press., United States of America., 2017
2. A Ghosh and A K Mallik. Theory of Mechanisms and Machines. East- West Press (P) Ltd. New Delhi
3. S S. Rattan, Theory of Machines, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2019
4. Sadhu Singh, Theory of Machines, Prentice Hall of India, New Delhi, 2011
5. Kenneth J .Waldron and Garny L. Kinzel, Kinematics, Dynamics and Design of Machinery, John Wiley and Sons (Asia) Pvt. Ltd., New Delhi, 2007

22AG405 HYDROLOGY **3 1 0 4**

Course Objectives

- To study the components of hydrologic cycle for assessing the occurrence and distribution of water
- To estimate the losses and yield of available water using various analytical methods
- To assess the methods for hydrological flood routing and drought occurrences

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. 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.

PSO1. Model, design and analyze agricultural machineries and implements to increase yields, improve land use and conserve conserve agricultural inputs

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Execute the hydrologic cycle and measure the interception losses including evaporation, transpiration, infiltration and infiltration indices
2. Implement various analytical and empirical methods for estimating the initial losses including interception, evaporation, transpiration, and infiltration
3. Analyze the runoff using analytical and empirical methods and compare the factors affecting the flow
4. Analyze the watershed characteristics and stream flow data using various types of hydrographs
5. Evaluate various methods and strategies for flood flow routing

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	-	1	-	1	1	-	-	-	-	-	-	-	2
2	2	2	2	1	-	-	2	-	-	-	-	-	-	-	2

3	3	2	1	2	-	-	2	-	-	-	-	-	1	-	3
4	2	2	2	3	-	-	2	-	-	-	-	-	-	-	3
5	1	2	3	2	-	-	1	-	-	-	-	-	1	-	-

UNIT I **9 Hours**

HYDROLOGIC CYCLE

Hydrologic cycle - precipitation - forms - rainfall measurement - mass curve - hydrograph - mean - rainfall depth - frequency analysis of point rainfall - plotting position - estimation of missing data - test for consistency of rainfall records

UNIT II **8 Hours**

INITIAL LOSSES

Interception - infiltration - evaporation - evapotranspiration - estimation and measurement - geomorphology of watersheds - stream number - stream length - stream area - stream slope and Horton laws

UNIT III **10 Hours**

RUNOFF

Runoff - factors affecting - measurement - stage and velocity - rating curve - extension of rating curve - estimation of peak runoff rate and volume - rational method - Cook method - SCS method - Curve number method

UNIT IV **9 Hours**

HYDROGRAPH

Hydrograph - components - base flow separation - unit hydrograph theory - unit hydrograph of different durations - dimensionless unit hydrograph - distribution hydrograph - synthetic unit hydrograph - uses and limitations of unit hydrograph

UNIT V **9 Hours**

FLOOD ROUTING

Head water flood control - methods - retards and their location - flood routing - graphical methods of reservoir flood routing - hydrology of dry land areas - drought and its classification - introduction to watershed management and planning.

Total: 45+15=60 Hours

Reference(s)

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

22HS007 ENVIRONMENTAL SCIENCES 2 0 0 0

Course Objectives

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

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

Course Outcomes (COs)

1. Apply principles of natural resource management to analyze exploitation cases in forestry, water, minerals, and agricultural sectors, assessing their environmental impacts.
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Analyze the existing environmental challenges related to pollution and its management
4. Analyze the impacts of unsustainable practices, waste management, climate change, and water conservation on environmental sustainability
5. Analyze the impact of population and human activities on environment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2	2	-	-	-	-	1	-	-	-	-	-	-	-	-
4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **6 Hours**

NATURAL RESOURCES

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

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

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

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - Water pollution - Sewage water treatment by activated sludge and trickling filter process - Noise pollution - Thermal pollution. Disaster management - causes - effects - control measures of floods - Earthquake

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

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

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

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

Total: 30 Hours

Reference(s)

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

22HS008 ADVANCED ENGLISH AND TECHNICAL EXPRESSION

0 0 2 1

Course Objectives

- To enable students to achieve proficiency in academic writing
- effectively use the language to persuade others
- appreciate the nuances of the language and engage an audience
- use advanced tools of language to improve communicative competence
- prepare for professional demands at the workplace
- give concrete expression to the plans and goals

Programme Outcomes (POs)

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Infer the clarity in articulating the objectives and aims and improved proficiency in using the English language
2. Communicate effectively and with good interpersonal skills; speak in public, engage the audience, and lead a group discussion
3. Evaluate the ethics of persuasive appeals and confidence to influence opinion
4. Analyse a specific piece of information; take in what is read, and use good writing techniques with proper grammar and syntax in all formal situations
5. Create awareness and empathy to emotional signals in communication

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
3	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-

UNIT I **15 Hours**

CREATIVE EXPRESSION

Proposals & Grant applications, Argumentative essays & editorials, Sales Pitches, Campaigning, Commercials/advertisements, effectively answering the famous interview question: ‘Why should we hire you?’ Sentence and paragraph formation - Rhetorical questions - Emphasis & effective repetition-

Empathetic expression, knowing the audience, capturing attention - Creating Memes, Comic Strips, Stand-up comedy, Caption writing, and Limericks, Vocabulary and slang words for comedy - Similes & Metaphors - Homophones, homonyms, alliteration, wordplay

UNIT II **15 Hours**

FORMAL EXPRESSION

Writing: Action plans, Cover letters, Mind-Mapping, Paragraph writing Logical reasoning - SVA - Advanced level - Style: Clarity, Concision, Coherence, Evocativeness, Efficacious Vocabulary - Conditional Clause - Be verbs- Tenses- advanced - Opening and closing sentences - Action plans, Anecdotal references, order of communication/ narration, complete communication- Wh-questions - Effective beginning and closing - Rhetorical questions - Appraising target audience - Pronunciation, Enunciation, Tone, Pace and Volume. - Writing: SOPs, Research Objectives, Thesis Statement, Indexing, Scholarly Articles, Academic Writing, Executive Summary, Survey Questionnaires, Citations and Bibliography - Reading: Quantitative Quantitative & qualitative analysis, Analysis and paraphrasing of reference materials Speaking: Commentate live events, give instructions to operate machines/ conduct experiments Listening: Informational listening, Reflective listening, - Discriminative listening - Connective words - Prefixes and Suffixes - Quoting and paraphrasing Proofreading - Directed writing and writing formats - Note taking - Active verbs

Total: 30 Hours

Reference(s)

1. Sangeeta Sharma et.al. Communication Skills for Engineers and Scientists, PHI Learning Pvt. Ltd, 2011
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001
4. Personality Development, Harold R. Wallace & L.Ann Masters, Cengage Learning, New Delhi
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji-Macmillan India Ltd. 1990, Delhi
6. English Grammar, Composition and Usage by N. K. Agrawal & F. T. Wood, Macmillan India Ltd., New Delhi

22HS010 SOCIALLY RELEVANT PROJECT - - - NC

Course Objectives

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

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.
PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO10. 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.
PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Interact with society conduct a field surveys and identify societal issues.
2. Analyze societal problems using engineering principles.
3. Develop plan and provide optimal solutions for social issues using their engineering knowledge and skills.
4. Prepare comprehensive reports on their findings and proposed solutions.
5. Enhance the social responsibility and ethical considerations in engineering.
6. Develop community interaction and managerial skills

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	2	-	-	2	-	-	3	3	3	-	2	-	-	-
2	3	3	-	-	-	-	-	3	3	3	-	2	3	-	-
3	2	-	3	-	2	-	-	3	3	2	-	2	2	-	-

4	-	-	-	-	-	-	-	2	2	2	-	2	-	-	-	-
5	-	-	-	-	-	-	-	3	3	3	-	2	-	-	-	-

Students have to interact with society, conduct a field survey and identify the issues / problems available in the society. Analyze the issues using engineering knowledge, skills and attitude and provide the optimal solutions to solve the social issues and submit the report.

Total 40 Hours

22AG501 TRACTOR AND FARM ENGINES 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO10: 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.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

Course Outcomes (COs)

1. Apply engine principles to analyze performance and design modern farm power systems
2. Analyze engine systems such as cooling, lubrication, fuel, electrical to select optimal configurations
3. Apply principles of transmission systems to compute speed ratios and select appropriate gearboxes for various applications
4. Analyze tractor mechanics and hydraulics to determine stability and control system performance
5. Apply testing procedures to assess power tiller and tractor performance per standards

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
2	3	2	-	-	2	1	-	-	-	-	-	-	1	-	-
3	1	2	1	-	-	-	-	3	-	-	-	-	2	-	-

4	-	-	-	-	3	2	-	-	-	-	-	-	2	-	-
5	-	-	-	2	-	-	-	-	-	3	-	-	3	-	-

UNIT I **10 Hours**

SOURCES OF FARM POWER AND ENGINE SYSTEM

Sources of farm power - conventional and non - conventional energy sources; classification of tractors and IC engines; thermodymanic principles of IC engine - CI and SI; engine - functional components and their construction, working principles; measurement of indicated horse power - theoretical and numerical method; comparison between two stroke and four stroke engine cycles and CI and SI engines - valve mechanism valve timing diagram and valve clearance adjustment, air cleaning system - types of air cleaners and perfomance characteristics of various aur cleaners; turbocharger; supercharger; emission characteristics of IC engine, biofuels in IC engine, modern trends in engine design

UNIT II **10 Hours**

COOLING, LUBIRCATION, FUEL SUPPLYAND ELECTRICAL SYSTEM

Engine cooling system - necessity, types, fucntional components and working principle; pressurized cooling; anti - freeze solutions; lubrication system - types of lubricants and systems, theories for the application of lubricants - fluid film theory and boundary layer theory, working principle; fuel supply system - fuels, properties of fuels, calculation of air - fuel ratio and calorific value; fuel test for SI and CI engines, detonation and knocking; carburetion system - types and its functional components; fuel injectio system - injection pump, their types, working principles; common rail fuel injection system; fuel injector nozzles - their types and working principle; engine governing - governor types and governor characteristics; ignition system of SI engines; electrical system - cranking of engine, battery and starting motor

UNIT III **9 Hours**

TRANSMISSION SYSTEM

Clutch - need, types, fucntional requirements, constructionand principle of operation; gear box - gearing theory, principle of operation, types of gear box, functional requirements and calculation for speed ratio; planetary gear system, torque converter; differential system - fucntional components, contruction, calculation for speed reduction; final drive and wheels; brake system - types, principle of operation; steering system - requirements, characteristics of steering geometry; fucntional components, front axle and wheel alignment, ackerman steering geometry

UNIT IV **9 Hours**

HYDRAULIC SYSTEMS AND TRACTOR MECHANICS

Hydraulic system - principle of operation, types, main functional components, functional requirements; familiarization with the hydraulic system - automatic draft and position control; tractor poweroutlets - PTO, PTO standards, types and functional requirements; wheels and tyres - solid tyres and pneumatic tyres, bias ply and radial ply tyres, tyre construction and tyre specifications; tractor mechanics - forces acting on the tractor in static and dynamic mode; determination of CG of a tractor and moment of inertia of a tractor; tractor static equilibrium, tractor stability especially at turns

UNIT V **7 Hours**

POWER TILLER AND TRACTOR TESTING

Power tiller - types, application, functional components and attachments; types of tests - test procedure - need for testing and evaluation of famr tractor and power tiller; test code for performance testing of tractors and power tillers - RNAM, BIS, etc

4 Hours

EXPERIMENT 1

Dismantle and assemble the internal combustion engine components used in tractor

4 Hours

EXPERIMENT 2

Overhauling the air filter components used in tractor

4 Hours

EXPERIMENT 3

Dismantle, inspect clean and reinstall Power Take Off shaft and drive the power tillers

4 Hours

EXPERIMENT 4

Execute servicing procedure of cooling system components used in tractor

5 Hours

EXPERIMENT 5

Overhauling the entire transmission system components used in tractor

5 Hours

EXPERIMENT 6

Execute Overhauling of steering and braking system components used in tractor

4 Hours

EXPERIMENT 7

Demonstrate the working of tractors and power tillers in the Agri field

Total: 45+30=75 Hours

Reference(s)

1. Liljedahl J B and Others. Tractors and Their Power Units., CBS Publisher New Delhi
2. Michal AM and Ojha TP. Vol I. Principles of Agricultural Engineering. Jain Brothers, New Delhi
3. Jain SC and CR Rai. Farm Tractor Maintenance and Repair
4. Tractor and automotive engines, In book: Glimpses of Agricultural Engineering (pp.28), New Delhi 2023
5. Ajit K. Srivastava, Carroll E. Goering, Roger P. Rohrbach, and Dennis R. Buckmaster. 2006. Engineering Principles of Agricultural Machines, 2nd ed. St. Joseph, Michigan: ASABE, Copyright American Society of Agricultural and Biological Engineers
6. https://doi.org/10.1007/978-3-030-32804-7

22AG502 UNIT OPERATIONS IN AGRICULTURAL PROCESS ENGINEERING 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO7. 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.

PSO2. To improvise better ways to minimize the crop loss from field damage during harvesting, sorting, processing and packaging

Course Outcomes (COs)

1. Analyze evaporation processes and design efficient systems considering heat balance
2. Apply mechanical separation principles to select and evaluate filtration and centrifugation equipment
3. Analyze size reduction and mixing principles to design appropriate equipment and predict product characteristics
4. Apply contact equilibrium principles to design gas absorption and extraction systems
5. Analyze crystallization and distillation principles to design and evaluate separation equipment performance

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	-	-	1	-	1	-	-	-	-	-	-	2	-
2	-	3	2	1	-	-	1	-	-	-	-	-	-	2	-
3	2	1	3	-	-	-	1	-	-	-	-	-	-	1	-
4	2	1	-	3	-	-	1	-	-	-	-	-	-	1	-
5	2	1	1	3	-	-	1	-	-	-	-	-	-	1	-

UNIT I **8 Hours**

EVAPORATION AND CONCENTRATION

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

UNIT II **8 Hours**

MECHANICAL SEPARATION

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

UNIT III **8 Hours**

SIZE REDUCTION AND MIXING

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

UNIT IV **11 Hours**

CONTACT EQUILIBRIUM SEPARATION

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

basket extractor- extraction of fine material - Dorr agitator - continuous leaching decantation systems - extraction towers- washing equipment

UNIT V **10 Hours**

CRYSTALLIZATION AND DISTILLATION

Crystallization - equilibrium -solubility and equilibrium diagram - rate of crystal growth equilibrium crystallization-crystallization equipment - classification - construction and operation-tank, agitated batch, Swenson-Walker vacuum crystallizers-distillation - binary mixtures - flash and differential distillation-steam distillation - theory - consumption - continuous distillation with rectification - vacuum distillation - batch distillation - operation and process - advantages and limitations - azeotropic distillation-distillation equipment- construction and operation - factors influencing the operation

FOR FURTHER READINGS

Unit operations involved in various food processing

3 Hours

EXPERIMENT 1

Concentrating milk using single effect evaporator

3 Hours

EXPERIMENT 2

Separation of butter from milk using a centrifugal separator

4 Hours

EXPERIMENT 3

Separation and collection of milk powder from air exiting spray dryer using cyclone separator

4 Hours

EXPERIMENT 4

Separation of liquid fruit juice from the solids using filtration and concentration using a rotary flash evaporator

4 Hours

EXPERIMENT 5

Determine the size of given food products using sieve analysis

4 Hours

EXPERIMENT 6

Size reduction of maize and rice using burr mill and pin mill

4 Hours

EXPERIMENT 7

Size reduction of sugar and wheat using a ball mill and hammer mill

4 Hours

EXPERIMENT 8

Determination of mixing index for wheat and corn flour

Total: 45+30=75 Hours

Reference(s)

1. McCabe, W.L. , J.C. Smith, and P. Harriott. Unit Operations in Chemical Engineering, 7th Edition. McGraw Hill Kogakusha Ltd, Tokyo, 2017
2. Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
3. Sahay K.M. & Singh K.K. Unit Operations of Agricultural Processing, 2nd Edition, 2004
4. Geankoplis,C.J., Transport Process and Unit Operations, Prentice-Hall of India Private Limited, New Delhi, 1999
5. Coulson,J.M. and J.F. Richardson, Chemical Engineering, Volume I to V. The Pergamon Press, New York, 1999

22AG503 SOIL AND WATER CONSERVATION ENGINEERING **3 1 0 4**

Course Objectives

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

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design solutions for complex engineering problems and design system components or processes thameet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: 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.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Analyze erosion types and apply control measures to design effective erosion management plans
2. Design erosion control structures by applying hydraulic principles and computing flow characteristics
3. Design drop spillways by analyzing hydraulic design principles and evaluating structural stability
4. Design chute spillways and other water management structures by applying design criteria and computing cost estimations
5. Apply water harvesting techniques to design farm ponds and improve crop production in dry farming

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	2	-	3	-	1	1	-	1	-	-	-	-	-	1
2	3	2	-	3	-	1	-	-	-	-	-	-	1		1
3	2	-	-	2	-	-	-	-	-	-	-	-	-	-	1
4	-	2	-	3	-	-	1	-	-	-	-	-	-	-	1
5	-	-	3	2	-	-	1	-	-	-	-	-	1	-	1

UNIT I **10 Hours**

EROSION TYPES AND CONTROL

Introduction; soil erosion - causes, types and agents of soil erosion; water erosion - forms of water erosion, mechanics of erosion; gullies and their classification, stages of gully development,; soil loss estimation - universal soil loss equation and modified soil loss equation, determination of their various parameters, wind erosion - factors affecting wind erosion, mechanics of wind erosion, soil loss estimation, wind erosion control measures - vegetative, mechanical measures, wind breaks & shelter belts, sand dunes stabilization

UNIT II **8 Hours**

EROSION CONTROL STRUCTURES

Introduction; classification of structures, functional requirements of soil erosion control structures; flow in open channels-types of flow, state of flow, regimes of flow, energy and momentum principles, specific energy and specific force; hydraulic jump and its application, type of hydraulic jump, energy dissipation due to jump, jump efficiency, relative loss of energy; runoff measuring structures-parshall flume, H - flume and weirs

UNIT III **9 Hours**

DROP SPILLWAY

Straight drop spillway - general description, functional use, advantages and disadvantages, structural parts and functions; components of spillway, hydrologic and hydraulic design, free board and wave free board, aeration of weirs, concept of free and submerged flow, structural design of a drop spillway-loads on headwall, variables affecting equivalent fluid pressure, determination of saturation line for different flow conditions, seepage under the structure, equivalent fluid pressure of triangular load diagram for various flow conditions, creep line theory, uplift pressure estimation, safety against sliding, overturning, crushing and tension

UNIT IV **10 Hours**

CHUTE SPILLWAY

chute spillway general description and its components, hydraulic design, energy dissipaters, design criteria of a SAF stilling basin and its limitations, drop inlet spillway- general description, functional use, design criteria; design of diversions; small earth embankments-their types and design principles, farm ponds and reservoirs, cost estimation of structures

UNIT V **8 Hours**

WATER HARVESTING

Land use capability classification; grassed water ways and their design; introduction to water harvesting techniques, Farm pond, Dry farming techniques for improving crop production

FOR FURTHER READING

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

Total: 45+15= 60 Hours

Reference(s)

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

22AG504 RENEWABLE ENERGY SOURCES 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. 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.

PSO3. Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in agriculture sector

Course Outcomes (COs)

1. Analyze biomass conversion technologies and apply principles to design efficient biomass energy systems
2. Apply biochemical conversion processes to produce biofuels and evaluate their characteristics and engine performance
3. Analyze solar radiation and design solar energy conversion systems for thermal and photovoltaic applications
4. Analyze wind patterns and design wind energy conversion systems for power generation and water pumping
5. Analyze hydro and ocean energy sources and apply energy auditing principles to assess sustainability

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	-	-	-	3	1	2	-	-	-	-	-	-	-	1
2	1	3	-	2	2	-	2	-	-	-	-	-	-	-	2
3	1	2	3	1	1	-	1	-	-	-	-	-	-	-	3
4	1	3	2	2	1	-	2	-	-	-	-	-	-	-	2
5	1	2	3	1	1	-	2	-	-	-	-	-	-	-	3

UNIT I **10 Hours**

RENEWABLE ENERGY SOURCES

Classification of energy sources; Introduction to renewable energy sources; characterization of biomass; types, construction, working principle, Biomass Combustion Technology, Gasifiers Technology, Biomass Gasification Methods, Removal of tar and impurities from gasification, Principles of pyrolysis and methods

UNIT II **8 Hours**

BIOCHEMICAL CONVERSION TECHNOLOGY-BIOGAS AND BIO FUELS

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

UNIT III **10 Hours**

SOLAR ENERGY CONVERSION SYSTEM

Solar radiation, insolation, Solar thermal - concentrating & non- concentrating collectors- types reflectors - solar thermal power stations principle and applications - solar stills- types- solar pond performance-characteristics applications. Basics of Solar Photovoltaics, Recent trends in solar drying-solar tunnel drier, Solar Driers, Solar PV and water pumping, Solar Water Heater

UNIT IV **8 Hours**

WIND ENERGY CONVERSION SYSTEM

Nature of wind - wind structure and measurement - wind power laws, Wind mill - classification - power curve. Upwind and downwind systems, Wind energy conversion principles, Wind mill- aero generator, Wind mill- water pumping

UNIT V **9 Hours**

HYDRO AND OCEAN ENERGY CONVERSION SYSTEM AND ENERGY AUDITING

Hydropower energy sources; hydropower types, sustainability; ocean energy conversion system, ocean thermal energy conversion system - thermodynamic efficiency - cycle type environment effect - technical difficulties; energy auditing - carbon foot print

FOR FURTHER READING
Energy Auditing and Management

4 Hours

EXPERIMENT 1
Create the Solar tracking path for the specific Solar panel for effective energy harvesting

5 Hours

EXPERIMENT 2
Predict the forecasting of Solar Direct Normal Irradiation (DNI) level in BIT Locations

4 Hours

EXPERIMENT 3
Select the suitable Solar tube collector to harvest 100 litre capacity of Solar water heater in domestic

4 Hours

EXPERIMENT 4
Suggest the suitable solar PV for 1 kW power requirement in domestic applications

4 Hours

EXPERIMENT 5
Select a Wind turbine based on the Wind availability in the BIT location

4 Hours

EXPERIMENT 6
Identify the water pump for 20 m head requirement in domestic application

5 Hours

EXPERIMENT 7
Estimate the Wind Energy conversion calculations in the BIT location

Total: 45+30= 75 Hours

Reference(s)

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

22AG507 MINI PROJECT I 0 0 2 1

Course Objectives

- Identify the problem statement and apply the engineering concepts to find the solution
- Improve the analysing capability of the students
- Increase the exuberance in finding the solution to various problems

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO11: 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.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Analyze a real-world problem and design a viable solution meeting specified requirements
2. Apply technical knowledge and strategies to construct a functional prototype or deliverable

3. Integrate new tools, algorithms, and techniques to enhance the project solution
4. Evaluate the prototype"s performance and assess its cost-effectiveness
5. Demonstrate project outcomes and justify their impact through a report and presentation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	1	1	2	-	-	2	2	2	-	1	1	1	1
2	1	2	1	1	2	-	-	2	2	2	-	1	1	1	1
3	1	2	1	1	2	-	-	2	2	2	2	1	1	1	1
4	1	2	1	1	2	-	-	2	2	2	2	1	1	1	1
5	1	2	-	-	2	-	-	2	2	2	-	1	1	1	1

Total: 30 Hours

22AG601 FARM IMPLEMENTS AND EQUIPMENT 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Assess the status of farm mechanization based on technical and economic factors
2. Analyze the primary tillage implements and its functions
3. Compare the secondary tillage implements and its functions
4. Assess the technical features and functionalities of sowing and intercultural implements
5. Select specialized farm implements including harvesters and threshers based on their test results

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	-	2	-	-	-	-	-	-	1	-	-
2	3	2	1	-	2	2	-	-	-	-	-	-	1	-	-
3	3	2	1	2	-	2	-	-	-	-	-	-	1	-	-

4	3	1	1	-	-	2	-	-	-	-	-	-	2	-	-
5	3	-	2	-	-	1	-	-	-	-	-	-	1	2	-

UNIT I **9 Hours**

FARM MECHANIZATION

Introduction to farm mechanization-objectives. Classification of farm machines. Tillage - objectives - methods - primary tillage implements - secondary tillage implements - animal drawn ploughs - construction. Identification and selection of machines for various operations on the farm. Hitching systems and controls of farm machinery. Types of farm implements - trailed, mounted and semi mounted implements. Calculation of field capacities and field efficiency. Calculations for economics of machinery usage, comparison of ownership with hiring of machines.

UNIT II **9 Hours**

PRIMARY TILLAGE IMPLEMENTS

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

UNIT III **9 Hours**

SECONDARY TILLAGE IMPLEMENTS

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

UNIT IV **9 Hours**

SOWING AND INTERCULTURAL EQUIPMENT

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

UNIT V **9 Hours**

HARVESTING, THRESHING AND TESTING OF FARM IMPLEMENTS

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

4 Hours

EXPERIMENT 1

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

2 Hours

EXPERIMENT 2
Operation of a tractor drawn disc plough - adjustments - determination of field capacity

2 Hours

EXPERIMENT 3
Hitching of mounted implements to the tractor and ploughing with mounted implements

4 Hours

EXPERIMENT 4
Operation of tractor drawn cultivator - adjustments- and determination of field capacity

2 Hours

EXPERIMENT 5
Operation of a subsoiler - adjustments - determination of field capacity

2 Hours

EXPERIMENT 6
Experiment on Calibration of seed drills

2 Hours

EXPERIMENT 7
Operation of seed planter and centrifugal broadcasting device in the field

2 Hours

EXPERIMENT 8
Operation and evaluation of dry land weeders and power operated weeder

4 Hours

EXPERIMENT 9
Dismantling, parts identification and assembly of different components of knapsack power sprayer and duster.

3 Hours

EXPERIMENT 10
Field-testing of rocker arm sprayer, power sprayer and boom sprayer

3 Hours

EXPERIMENT 11
Determination of operational cost of farm implements

Total: 45+30=75 Hours

Reference(s)

1. Kepner RA, Roy Barger & EL Barger. Principles of Farm Machinery, CBS Publisher Delhi
2. Michal AM and Ojha TP. Vol I. Principles of Agricultural Engineering. Jain Brothers, New Delhi.
3. Farm Tools and Equipment's for Agriculture, authored by: Surendra Singh, 2016
4. A Textbook of Farm Machinery and Equipment: Principles and Practice Paperback, by T. Senthilkumar (Author), B. Suthakar (Author), G. Manikandan (Author), 2023
5. https://www.researchgate.net/publication/323771721_Farm_Machinery_and_Equipment-I_Practical_Manual

22AG602 POST HARVEST TECHNOLOGY 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Assess the different engineering properties of agricultural products and assess their importance
2. Analyze the working principles of grain cleaning and grading devices and select suitable equipment for cereal grains, oilseeds, and pulses
3. Assess the performance of conveying and storage systems used for agricultural products for better processing
4. Classify various methods for processing of the cereals, pulses, and oil seeds based on their properties
5. Evaluate the post-harvest operations for horticultural crops to increase the market value of food products

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	-	-	-	3	1	2	-	-	-	-	-	1	2	-
2	1	3	-	2	2	-	2	-	-	-	-	-	-	2	-
3	1	2	3	1	1	-	1	-	-	-	-	-	-	2	-
4	1	3	2	2	1	-	2	-	-	-	-	-	-	2	-
5	1	2	3	1	1	-	2	-	-	-	-	-	-	3	-

UNIT I **8 Hours**

INTRODUCTION

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

UNIT II **10 Hours**

CLEANING, GRADING AND DRYING

Principles, air screen cleaners: types, adjustments. Cylinder separator, spiral separator, magnetic separator, colour sorter, inclined belt separator, length separators, effectiveness of separation and performance index. Different types of graders for cereals, pulses and oil seed crops. Drying: moisture content and water activity; Free, bound and equilibrium moisture content, isotherm, hysteresis effect, EMC determination, Drying principles and theory, Thin layer and deep bed drying analysis, Falling rate and constant rate drying periods, maximum and decreasing drying rate period, drying equations, Dryer performance, Different methods of drying, types of grain dryers: dryers: bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray

UNIT III **9 Hours**

MATERIAL HANDLING AND STORAGE

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

UNIT IV **9 Hours**

PROCESSING OF CEREALS, PULSES AND OILSEEDS

Paddy processing: parboiling of paddy, methods, merits and demerits, dehusking of paddy: methods, merits and demerits; rice polishers: types, constructional details, polishing, layout of modern rice mill, performance evaluation of modern mills. Wheat milling, pulse milling methods. Oil seed processing, Sugarcane crushing, extraction recovery and processing of jaggery. Principles and operation: maize sheller, husker sheller for maize, groundnut decorticator, castor sheller.

UNIT V **9 Hours**

PROCESSING OF FRUITS AND VEGETABLES

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

FOR FURTHER READING

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

3 Hours

EXPERIMENT 1

Determination of moisture content of grains by oven-dry method and draw the drying characteristic curves

4 Hours

EXPERIMENT 2

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

4 Hours

EXPERIMENT 3

Determination of coefficient of friction and angle of repose of different grains

3 Hours

EXPERIMENT 4

Determination of shelling efficiency of groundnut decorticator

4 Hours

EXPERIMENT 5

Performance evaluation of paddy parboiling, rubber roll sheller and cone polisher

4 Hours

EXPERIMENT 6

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

4 Hours

EXPERIMENT 7

Evaluation of efficiency of a grain cleaning cum grading machine

4 Hours

EXPERIMENT 8

Determining the oil content of oil seeds using Soxhlet apparatus

Total: 45+30=75 Hours

Reference(s)

1. McCabe, W.L. , J.C. Smith, and P. Harriott. Unit Operations in Chemical Engineering, 7th Edition. McGraw Hill Kogakusha Ltd, Tokyo, 2017
2. Chakraverty, A. Post Harvest Technology of cereals, pulses and oilseeds. 3rd Edition. Oxford & IBH publishing Co. Ltd., New Delhi.2019

3. Sahay, K.M. and Singh, K.K. Unit operations of Agricultural Processing. Vikas Publishing house Pvt. Ltd. New Delhi.1994
4. Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
5. Henderson, S.M., and Perry, R. L. Agricultural Process Engineering, Chapman and hall, London. 1955
6. Singh, R. Paul. and Heldman, R.Dennis. Introduction to Food Engineering. 3rd Edition. Academic Press, London. 2004

22AG603 IRRIGATION AND DRAINAGE ENGINEERING

3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Assess the development and utilization of water resources in India as well as Tamil Nadu and estimate the evapo-transpiration using direct and indirect methods for scheduling the irrigation for various crops
2. Determine irrigation requirements of crops and plan the irrigation schedule for different crops including irrigation efficiencies.
3. Compare different methods of surface irrigation and their adaptability to the specific characteristics of soil, topography and crops
4. Analyze the technical features of agricultural drainage systems and design criteria for its various components
5. Design, monitor and maintain the surface and subsurface drainage systems for controlling the salinity and water logging in the agricultural area

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	2	3	2	2	1	1	-	-	-	-	-	1	-	-	1
2	2	3	2	2	1	1	-	-	-	-	-	1	-	-	2
3	1	2	3	2	2	-	-	-	-	-	-	-	-	-	3
4	2	2	3	1	-	-	-	-	-	-	-	2	-	-	2
5	2	1	3	2	-	-	-	-	-	-	-	1	-	-	1

UNIT I **9 Hours**

IRRIGATION WATER AND ITS MEASUREMENT

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

UNIT II **9 Hours**

IRRIGATION REQUIREMENT

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

UNIT III **9 Hours**

METHODS OF IRRIGATION

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

UNIT IV **9 Hours**

AGRICULTURAL DRAINAGE SYSTEM

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

UNIT V **9 Hours**

DESIGN OF AGRICULTURAL DRAINAGE SYSTEM AND SALT BALANCE

Design of subsurface drainage system. Drainage materials, drainage pipes, drain envelope. Layout, construction and installation of drains. Drainage structures. Vertical drainage. Bio-drainage. Tile Drains.

Drainage of irrigated and humid areas. Salt balance, reclamation of saline and alkaline soils. Leaching requirements, conjunctive use of fresh and saline waters. Economic aspects of drainage.

FOR FURTHER READING

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

3 Hours

EXPERIMENT 1

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

3 Hours

EXPERIMENT 2

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

3 Hours

EXPERIMENT 3

Problems on duty of water - Duty and delta relationship

3 Hours

EXPERIMENT 4

Estimation of water requirement by different methods

3 Hours

EXPERIMENT 5

Estimation of Evapotranspiration

3 Hours

EXPERIMENT 6

Land Levelling Plane method from climatologically data

3 Hours

EXPERIMENT 7

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

3 Hours

EXPERIMENT 8

Problems on irrigation efficiencies and design of border irrigation systems

3 Hours

EXPERIMENT 9

Design of Basin and Furrow irrigation Problems

3 Hours

EXPERIMENT 10

Design of underground pipeline system

Total: 45+30=75 Hours

Reference(s)

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

22AG607 MINI PROJECT II **0 0 2 1**

Course Objectives

- Identify the problem statement and apply the engineering concepts to find the solution
- Improve the analysing capability of the students
- Increase the exuberance in finding the solution to various problems

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO11: 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.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

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

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	1	1	2	-	-	2	2	2	-	-	1	1	1
2	1	2	1	1	2	-	-	2	2	2	-	-	1	1	1
3	1	2	1	1	2	-	-	2	2	2	2	-	1	1	1
4	1	2	1	1	2	-	-	2	2	2	2	-	1	1	1
5	1	2	-	-	2	-	-	2	2	2	-	-	1	1	1

Total: 30 Hours

22AG701 REMOTE SENSING AND GIS APPLICATIONS **2 0 2 3**

Course Objectives

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

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3: 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.
PO4: 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.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Compare different electromagnetic radiations and assess their applications in remote sensing systems and satellite data processing
2. Assess the methods and tools for remote sensing-based digital image processing
3. Infer the features and advantages of Geographic Information System (GIS) geospatial data analysis
4. Select various tools and techniques available for geospatial data analysis using GIS platform
5. Justify the applications of RS and GIS tools for natural resource management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	-	3	-	-	1	-	-	-	-	1	1	-	-
2	2	-	-	3	-	-	1	-	-	-	-	-	-	-	2
3	1	-	2	3	-	-	2	-	-	-	-	-	-	2	-

4	-	-	-	3	-	-	-	-	-	-	-	-	3	-	2
5	-	-	-	3	-	-	-	-	-	-	-	2	1	-	3

UNIT I **6 Hours**

BASICS OF REMOTE SENSING

Definition of remote sensing and its components -Electromagnetic spectrum - wavelength regions important to remote sensing - Wave theory, Particle theory, Stefan-Boltzman and Wein Displacement Law - Atmospheric scattering, absorption - Atmospheric windows - spectral signature concepts - typical spectral reflective characteristics of water, vegetation and soil. Types of platforms - orbit types, Sunsynchronous and Geosynchronous - Passive and Active sensors. Indian Space Programme, Sensor characteristics LANDSAT, SPOT, ERS, IKONOS, IRS and others.

UNIT II **6 Hours**

IMAGE INTERPRETATION AND ANALYSIS

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

UNIT III **6 Hours**

GEOGRAPHIC INFORMATION SYSTEM

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

UNIT IV **6 Hours**

GEOSPATIAL ANALYSIS

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

UNIT V **6 Hours**

RS AND GIS APPLICATIONS

Crop Acreage estimation - Estimation of Crop Water Requirement Crop condition - Soil mapping - classification of soil with digital numbers - soil erosion mapping- reservoir sedimentation using image processing - Water quality modeling - Drought monitoring - Cropping pattern change analysis. Application of Remote Sensing and GIS in Precision Agriculture - Monitor Crop Health.

FOR FURTHER READING

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

3 Hours

EXPERIMENT 1

Aerial and Satellite images interpretation - visual

3 Hours

EXPERIMENT 2
Supervised classification practice

4 Hours

EXPERIMENT 3
Unsupervised classification practice

4 Hours

EXPERIMENT 4
Spatial data input and editing- Digitizing

4 Hours

EXPERIMENT 5
Raster analysis problems - Database query

4 Hours

EXPERIMENT 6
GIS applications in DEM and its analysis

4 Hours

EXPERIMENT 7
GIS application in watershed analysis

4 Hours

EXPERIMENT 8
GIS application in rainfall-runoff modeling

Total: 30+30=60 Hours

Reference(s)

1. Lillesand, T. M., and Kiefer, R.W., Remote Sensing and Image Interpretation, John Wiley and Sons, New York, 2000
2. P.A. Burrough, Principle of GIS for land resources assessment, Oxford Publications, 1990
3. Ian Heywood, an Introduction to GIS, Pearson Education, New Delhi, 2001
4. Basudeb Bhatta, Remote Sensing and GIS, II Edition, Oxford University Press, New Delhi, 2011
5. Floyd F.Sabins, Remote Sensing: Principles and Interpretation, III edition, Freeman and Company, New York, 1997
6. M.Anji Reddy, Textbook of Remote Sensing and Geographical Information System, 3rd Edition, BS Publications, 2008

22AG702 FOOD AND DAIRY ENGINEERING 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO11: 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.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging

Course Outcomes (COs)

1. Assess the physical, mechanical, thermal, rheological and electrical properties of food material and differentiate various thermal treatments for food products.
2. Compare food drying systems and assess their limitations in applying different food products
3. Assess the physical, chemical and thermal properties of milk and compare its processing techniques
4. Design various milk processing equipment and evaluate their performance
5. Assess non-thermal processing for various food products and application of Nanotechnology in food processing

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	1	1	-	-	-	-	-	1	-	-	2	-
2	2	1	3	2	1	1	-	-	-	-	-	-	-	2	-
3	1	2	3	2	1	-	-	-	-	-	1	-	1	1	-
4	3	1	1	1	1	1	-	-	-	-	-	-	2	3	-
5	1	2	1	1	1	-	-	-	-	-	1	-	1	3	-

UNIT I **9 Hours**

BASIC PROPERTIES AND THERMAL PROCESSING OF FOODS MATERIALS

Constituents of food and their energy values - rheological properties of food materials- texture of food materials -viscometry - Concentrations of foods - freeze concentration - membrane concentration -Thermal processing of foods - product-time-temperature relationships - cooking, blanching pasteurization techniques- UHT Processing - sterilization of solid and liquid foods- batch and continuous sterilization equipment-interaction of heat energy on food components - kinetics of microbial destruction - Preservation by retort processing - principles and applications - microwave and radio frequency heating in food processing- Canning- Aseptic packaging.

UNIT II **9 Hours**

DRYING AND DEHYDRATION

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

UNIT III **9 Hours**

MILK PROCESSING

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

UNIT IV **9 Hours**

DAIRY EQUIPMENT AND PRODUCTS

Homogenisation - theory and working of homogenisers - high pressure homogenization of milk and other food suspensions - design criteria for homogenizing equipment- cream separation principles - types of separators. Clarifiers - butter churns - ghee manufacture - equipment - whey manufacture- techniques - equipment - ice cream freezers - condensed milk - milk powder manufacturing drying equipment- milk products - paneer - casein - probiotic dairy products - kefir- milk plant sanitation requirements - Cleaning in place and its functions

UNIT V **9 Hours**

NONTHERMAL PROCESSING AND NANOTECHNOLOGY

Non-thermal and other alternate thermal processing in Food processing - Nanotechnology- History- fundamental concepts - tools and techniques. Nanomaterials - applications in food packaging and products, implications, environmental impact of nanomaterials and their potential effects on global economics, regulation of nanotechnology.

FOR FURTHER READING

Waste utilization and energy conservation in dairy industry - Utilisation of whey for energy generation through bio-methanation, energy conservation opportunities in dairy industry and packaging of dry products

3 Hours

EXPERIMENT 1

Estimation of microbial load in food materials

3 Hours

EXPERIMENT 2

Estimation of thermal processing time and degree of sterilization in canned food using a batch sterilizer

3 Hours

EXPERIMENT 3

Measurement of fat globule size in milk and determination of homogenization efficiency

3 Hours

EXPERIMENT 4

Determination of the separation efficiency of cream separator

3 Hours

EXPERIMENT 5

Determination of water activity and construction of moisture sorption isotherm of food materials

3 Hours

EXPERIMENT 6

Determination of overall heat transfer coefficient for an evaporator used for concentration of milk.

3 Hours

EXPERIMENT 7

Experiment on osmotic dehydration of foods

3 Hours

EXPERIMENT 8

Determination of rehydration ratio of dehydrated foods and Experiment on food extruder and determination of thermal conductivity of food materials

3 Hours

EXPERIMENT 9

Estimate the microbial inactivation rate using UV treatment.

3 Hours

EXPERIMENT 10

Measurement and estimation of textural parameters of a solid food and properties of parboiled and raw rice

Total: 45+30= 75 Hours

Reference(s)

1. H.G.Kessler, Food Engineering and Dairy Technology, Freising, Germany, Verlag A.Kessler, 1981
2. Norman N. Potter and Joseph H. Hotchkiss, Food Science, Fifth Edition, Food Science Text Series, 3. ISBN: 978-1-4613-7263-9 (Print) 978-1-4615-4985-7 (Online), 1995
3. Gordon L. Robertson, Food Packaging- Principles and Practice Marcel Dekker Inc, USA, 1993
4. Sukumar De, Outlines of Dairy: Technology, Oxford University Press, 2001
5. Murlidhar Meghwal, Megh R. Goyal, Rupesh S. Chavan, Dairy Engineering; Advanced Technologies and their Applications, CRC Press, 2016.

22AG707 PROJECT WORK I 0 0 4 2

Course Objectives

- Work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth
- Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications
- Effectively communicate information relating to all aspects of the design process in written, oral, and graphical form

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO11: 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.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector

Course Outcomes (COs)

1. Select a real world problem, identify the requirement and develop the design solutions
2. Design technical ideas, strategies and methodologies
3. Implement the new tools, algorithms, techniques that contribute to obtain the solution of the project
4. Judge the results of testing and validation through conformance of the developed prototype and analysis the cost effectiveness
5. Outline and present the oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	3	1	3	3	3	3	3	-	2	3	3	3
2	2	2	3	3	1	3	3	3	3	3	-	2	3	3	3
3	2	2	3	3	3	3	3	3	3	3	2	2	3	3	3
4	2	2	3	3	3	3	3	3	3	3	2	2	3	3	3
5	2	2	-	-	2	-	-	3	3	3	-	2	3	3	3

Total: 60 Hours

22AG801 PROJECT WORK II **0 0 20 10**

Course Objectives

- Work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth
- Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications
- Effectively communicate information relating to all aspects of the design process in written, oral, and graphical form

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO11: 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.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

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

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	3	1	3	3	3	3	3	-	2	3	3	3
2	2	2	3	3	1	3	3	3	3	3	-	2	3	3	3
3	2	2	3	3	3	3	3	3	3	3	2	2	3	3	3
4	2	2	3	3	3	3	3	3	3	3	2	2	3	3	3
5	2	2	-	-	2	-	-	3	3	3	-	2	3	3	3

Total: 300 Hours

22HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Command over the English language for day-to-day transactions.
- Improve listening and reading skills
- Increase ability to comprehend complex content
- Enhance confidence in expressing with clarity and elegance
- Enthusiastic and reflective use of the language through sufficient and focused practice
- Articulate fluently and confidently in challenging situations

Programme Outcomes (POs)

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. 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.
PO12. Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Engage with the English language in functional contexts
2. Express in both descriptive and narrative formats
3. Interpolate and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
2	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
3	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
4	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-
5	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-

UNIT I **15 Hours**

SELF-EXPRESSION

Personal Goals and Values - Being a Team Player-Expressing strengths and Weaknesses-Abstract nouns -Adjectives-Active Listening Skills-Note Making-Pronunciation and Accent Personal goals and values -Reading for Gist and Details-Professional Ethics-Reported Speech- Conjunctions Reading skills - phonemics, word/phrase recognition, sight words Personal Goals and Values- Conditional clauses-Hypothetical questions and Answers-Sentence Structure-Simple Present Tense- Perfect tense

UNIT II **15 Hours**

CREATIVE EXPRESSION

Instructive and Expository Expression - Creating brochures, catalogues, and manuals for products/ services, Giving directions, Process writing, Sequencing experiments, Concept Explanation- Reported Speech-Voice Sentence Equivalence-Proofreading

UNIT III **15 Hours**

FORMAL EXPRESSION

Notices and Announcements-Writing: Creating notices and circulars for events, announcing college tours and lost and Found-Varied Vocabulary - Gender Sensitive Vocabulary, Non-discriminatory Vocabulary, Concise Vocabulary-Paragraph writing - Effective titles, topics and supporting sentences, calling in registrations and queries. Effective communication- Understanding purpose, reach and target audience, achieving complete communication Punctuation - Capitalization, Numeration, Use of proper nouns and Articles-Spelling-Reading: Analyzing and interpreting notices and Circulars-Understanding the gist of short real-world notices, and messages. Culling out keywords Information words vs Supporting words-Interpreting Abbreviations, Acronyms and Short- forms-Listening: Analyzing and interpreting announcements Decoding - Screening for salient points-Note making-Raising queries for clarification-Speaking: Announcements-Giving complete information-Pronunciation and Enunciation Pace, Intonation, and Pitch-Conducting Events- Speaking: Master of ceremonies, Short speeches - welcome speech, the vote of thanks/ valedictory speech, award-acceptance speech Writing: Invitations, Preparation of script/draft after interviewing someone. Adjectives-Pronunciation/ Punctuation Precision and Concision-Politeness markers

Total: 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking FoundationBooks, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010.
4. Reynolds, John. Cambridge First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

22HSH01 HINDI 1 0 2 2

Course Objectives

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

Programme Outcomes (POs)

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day- to -day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Apply appropriate grammar to write and speak in Hindi language
4. Comprehend the conversation and give correct meaning
5. Take up Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
2	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-

UNIT I **9 Hours**

VOWELS AND CONSONANTS

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

UNIT II **9 Hours**

NOUNS

Nouns: Genders -Masculine & Feminine -Reading Exercises

UNIT III **9 Hours**

PRONOUNS AND TENSES

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

UNIT IV **9 Hours**
CLASSIFIED VOCABULARY
Classified Vocabulary: Parts of body -Relatives Spices Eatables -Fruit & Vegetables -Clothes - Directions -Seasons Professions.

UNIT V **9 Hours**
CONVERSATIONS
Speaking - Telling the times -Saying the Numbers from 1 to 50 Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

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

22HSG01 **GERMAN** **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios

Programme Outcomes (POs)

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

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

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
2	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-

UNIT I **9 Hours**

INTRODUCTION

Introduction to the German language-Alphabets-Numbers Greetings -Days and Seasons-Working with Dictionary.

UNIT II **9 Hours**

LANGUAGE AND ITS COMMON USE

Nouns -articles-Speaking about oneself-Listening to CD supplied with books-paying special attention to pronunciation

UNIT II **9 Hours**

TECHNICAL DEUTSCHE

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

UNIT IV **9 Hours**
INTERROGATION
Question words -Types of Questions -Nominative case-Verb Conjugation -country nationalitie

UNIT V **9 Hours**
IMPLEMENTATION
Verbs to be & to have -conjugation -Hobbies -Framing basic Questions and answers

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015.
2. Langenscheidt Eurodictionary, German English / English German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009.
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

22HSJ01 JAPANESE 1 0 2 2

Course Objectives

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

Programme Outcomes (POs)

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

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

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
2	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-

UNIT I 9Hours

SELF INTRODUCTION / DEMONSTRATIVES / NOUN MODIFIERS

Introduction to Japanese Japanese script - Pronunciation of Japanese(Hiragana (Katakana) Long vowels-Pronunciation of in,tsu,ga -Letters combined with ya,yu,yo - Daily Greetings and Expressions Numerals. Speaking: Self Introduction - Listening: Listening to Greetings, Listening to specific information: Numbers, Time

UNIT II 9Hours

TIME EXPRESSION / VERBS - PAST

Introduction to time -Introduction of verbs -Listening to specific information

UNIT III 9Hours

ADJECTIVES

Word Sentence -Introduction to Adjectives -Technical Japanese Vocabulary -Pair Activity Day to day situational conversation. Listening to Japanese Alphabet Pronunciation -Simple Conversation

UNIT IV **9 Hours**

CONJUGATION OF II ADJECTIVE

Past tense of Noun sentences and Na adjective sentences -Past tense of ii adjective sentences -houga adjective desu -Technical Japanese Vocabulary -Individual Activity - Listening to conversation with related particles

UNIT V **9 Hours**

CONJUGATION OF VERBS - TE FORM / TA FORM / NAI FORM / PLAIN FORM

N gahoshidesu - V masu form tai desu - Verb te form - Technical Japanese Vocabulary -Listening to different Counters, simple conversations with verbs and adjectives

Total: 45 Hours

Reference(s)

1. Minna no Nihongo Japanese for Everyone Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. Minna no Nihongo Japanese for Everyone Elementary Main Textbook 1-2 Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

22HSF01 FRENCH 1 0 2 2

Course Objectives

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

Programme Outcomes (POs)

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

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

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
2	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-

UNIT I 9 Hours

ENTRER EN CONTACT

La langue franÃƒÂ§aise, alphabets, les numÃƒÂ©ros, les jours, les mois. Grammaire Les verbes s appeler, etre, avoir, les articles definis, indefinis Communication Saluer, s informer sur quelqu un, demander de se presenter Lexique L alphabet, les nationalites, l age, les pays, les couleurs, les jours de la semaine, les mois de l annee, les professions

UNIT II 9 Hours

PARTAGER SON LIEU DE VIE

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

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN LES LOISIRS DES FRANCAIS, LES GOUTS DES AUTRES, LES ACTIVITES QUOTIDIENNES

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

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT SOUVRIR A LA CULTURE

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

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

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

Total: 45 Hours

Reference(s)

1. Grammaire Progressive du Francais, CLE International, 2010
2. Saison1, Marie Noelle Cocton et al, Didier, 2014.
3. Preparation a l examen du DELF A1 Hachette
4. Reussir le DELF A1 Bruno Girardeau
5. Website: Francais Linguaphone Linguaphone Institute Ltd., London, 2000.
6. Francais Harrisonburg : The Rosetta Stone : Fairfield Language Technologies, 2001

22AG001 HUMAN ENGINEERING AND SAFETY 3 0 0 3

Course Objectives

- To know about the importance of ergonomics
- To design agricultural machinery, equipment, implements and tools that suits comfort for work
- To know about the safety in design and operation of agricultural machinery

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Evaluate the significance of ergonomics and its applications in agricultural practices
2. Analyze anthropometric data and implement measurement techniques for ergonomic assessment.
3. Design effective control systems and workspace layouts for enhanced safety and efficiency.
4. Integrate anthropometric principles into the development of agricultural implements
5. Implement workplace safety standards to ensure hazard-free farm operations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	-	3	-	-	-	1	-	-	-	-	2	1	1
2	2	2	-	3	1	2	-	-	-	-	-	-	2	2	2
3	2	2	3	3	2	1	-	2	-	-	-	-	2	1	1

4	1	1	-	3	2	2	-	1	-	-	-	-	1	1	1
5	2	-	3	-	2	1	-	1	-	-	-	-	1	2	2

UNIT I **8 Hours**

ERGONOMICS

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

UNIT II **9 Hours**

PHYSIOLOGICAL FUNCTION

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

UNIT III **9 Hours**

ENERGY EXPENDITURE

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

UNIT IV **10 Hours**

ANTHROPOMETRY

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

UNIT V **9 Hours**

HUMAN SAFETY

Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation.

FOR FURTHER READING

Analysis of case studies on ergonomic study of different farm implements and machinery

Total: 45 Hours

Reference(s)

1. Sanders,M.S. and McComack,EJ. Human factors in Engineering and Des ign. Tata McGraw Hill, New York, 1992
2. Obome, David.J. Engieering Work. John Wiley and Sons Ltd., 1982
3. Astand, P.P. and Rodaid,K. Text book of Work Physiology, McGraw Hill Book Company,New York, 1970
4. Grandjean,E. Fitting the Track of the Man, Taylor and France Ltd., U.K.,1981

22AG002 DESIGN OF AGRICULTURAL MACHINERY **3 0 0 3**

Course Objectives

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

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO11: 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.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

Course Outcomes (COs)

1. Analyze the design considerations of farm machinery and implements for optimal performance
2. Evaluate the factors influencing the design and construction of primary tillage implements.
3. Design secondary tillage implements to enhance efficiency in agricultural operations
4. Assess the working principles and structural design of seed drills and planters.
5. Develop innovative plant protection and harvesting equipment for improved productivity.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	2	2	3	3	1	1	2	1	-	-	-	1	2	-	-
2	2	2	3	3	1	2	1	-	-	-	-	-	3	-	-
3	2	2	3	3	-	1	1	1	-	-	1	-	3	-	-
4	2	2	3	2	1	1	1	1	-	-	-	-	2	-	-
5	1	-	3	-	-	2	2	1	-	-	-	-	2	-	-

UNIT I **9 Hours**

INTRODUCTION

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

UNIT II **9 Hours**

DESIGN OF PRIMARY TILLAGE IMPLEMENTS

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

UNIT III **9 Hours**

CONSTRUCTION OF SECONDARY TILLAGE IMPLEMENTS

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

UNIT IV **9 Hours**

DESIGN AND CALIBRATION OF SEED DRILL/PLANTER

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

UNIT V **9 Hours**

DESIGN OF PLANT PROTECTION AND HARVESTING MACHINERY

Types of sprayers- components-nozzle types-selection of nozzles- spray pattern analysis. Harvestersreapers-combine harvesters-threshers- special equipment for harvesting and threshing - maintenance inspection for safety.

FOR FURTHER READING

Design of power equipment, precision farming tools, design standards

Total: 45 Hours

Reference(s)

1. Samuel Matz, The Chemistry and Technology of Cereals as Food and Feed, Chapman & Hall, 1992
2. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman), Oxford, UK,1994
3. D.N.Sharma, and S. Mukesh. Farm machinery design: Principles and problems. Jain brothers, 2019.
4. H.P. Smith. Farm machinery and equipment. Read Books Ltd, 2020.
5. C. Culpin. Farm machinery. Read Books Ltd, 2013.
6. R. L. Norton, Design of Machinery, Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi, 2004

22AG003 TESTING AND EVALUATION OF FARM MACHINERY AND EQUIPMENT

3 0 0 3

Course Objectives

- To Learn the procedure for testing of tractors and all other agricultural equipment and machinery
- To understand test codes of various countries for testing farm machinery and implements
- To analyse the performance of farm machinery and implements

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

Course Outcomes (COs)

1. Implement testing procedures and standards for tractor performance evaluation
2. Analyze the efficiency of tillage and sowing equipment based on standard testing methods.
3. Assess the functionality of intercultural equipment using prescribed testing procedures.
4. Evaluate the operational performance of harvesting equipment through standardized testing
5. Ensure compliance with safety standards and testing protocols for agricultural machinery and implements.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	3	1	1	1	2	-	-	-	-	3	-	-
2	2	3	2	3	1	1	1	1	-	-	-	-	3	-	-

3	2	2	2	3	1	1	1	1	-	-	-	1	3	-	-
4	2	2	2	3	2	1	1	1	-	-	-	-	3	-	-
5	2	2	2	-	3	2	1	3	-	-	-	-	2	-	-

UNIT I **10 Hours**

TESTING OF AGRICULTURAL TRACTORS

Testing and evaluation system in India - Agricultural machinery situation -Mechanization policy -future prospects - standardization efforts-type of testing systems-type of testing systems, General regulations-terminology- basic measurements, speed, fuel consumption, smoke density and power measurement-test items, specifications checking-PTO performance test-engine test, drawbar performance test-field test procedures -interpretation of results

UNIT II **9 Hours**

TESTING OF TILLAGE AND SOWING EQUIPMENT

Testing of tillage machinery - laboratory test (hardness testing, chemical analysis) - field test (rate of work, quality of work, draft measurement, fuel consumption) - seed drill - laboratory test (seed drill calibration) - field checking and field tests

UNIT III **9 Hours**

TESTING OF INTERCULTURAL EQUIPMENT

Testing and evaluation of weeders - types of tests for weeder - types of pesticide application equipment - terminology - types of tests for sprayers - testing methods - types of test for duster -testing methods

UNIT IV **9 Hours**

TESTING OF COMBINE HARVESTER

Types of grain combines - combine systems - test items - procedure for laboratory testing - materials for field test - observations during field tests - sample analysis- data analysis - summary of performance parameters - analysis of field test data

UNIT V **8 Hours**

SAFETY TESTING OF AGRICULTURAL MACHINERY

Types of agricultural machinery accidents - causes of agricultural machinery accidents - technical measurements for ensuring safety - methods of safety testing- ROPS and FOPS -safety precautions

FOR FURTHER READING

Testing of dryers and processing machinery-Case studies

Total: 45 Hours

Reference(s)

1. Metha M.L., SR.Verma, K Mishra and VK Sharma. 1995. Testing and Evaluation of Agricultural Machinery, National Agricultural Technology Information Centre, Ludhiana
2. Indian Standards Test Codes related to tractors, power tillers and agricultural implements. Ministry of Agriculture, Govt. of India
3. ASABE. 1983. RNAM Test Codes & Procedures for Farm Machinery. Technical Series 12
4. Nebraska Tractor Test Codes for Testing Tractors, Nebraska, USA.

22AG004 FARM POWER AND MACHINERY MANAGEMENT **3 0 0 3**

Course Objectives

- To analyse mechanization status in the country and management techniques for future requirements.
- To apply the management concepts for farming practices

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO11: 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.
PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector

Course Outcomes (COs)

1. Analyze the current status and trends of farm mechanization in India.
2. Evaluate the cost of machinery and operational expenses for effective budgeting.
3. Select optimal agricultural machinery based on efficiency and suitability for operations.
4. Formulate a comprehensive farm mechanization plan for enhanced productivity
5. Design and establish custom hiring centers to support sustainable farming practices.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	1	1	3	1	1	1	-	-	-	-	-	1	1	1
2	1	1	1	2	-	-	-	-	-	-	3	2	1	1	1
3	1	1	1	2	1	1	1	1	-	-	3	1	1	1	1
4	-	1	-	3	-	2	1	-	-	-	3	-	1	1	1
5	-	1	-	2	-	1	1	-	-	-	3	2	1	1	1

UNIT I **9 Hours**

FARM MECHANIZATION

The role of farm mechanization and its relationship to productivity, employment, social and Technological change- Farm Power availability- Mechanization status in India-performance index of power source and farm machinery -Scheduling of farm operations

UNIT II **9 Hours**

COST ANALYSIS

Farm records and inventory control - cost analysis of machinery- fixed cost and variable costs, effect of inflation on cost; Cost economics of tractor and farm machinery - land preparation, planting , intercultural, plant protection and harvesting machinery cost calculation

UNIT III **10 Hours**

MACHINERY SELECTION

Selection of tractor and farm machinery - Matching implements for different hp- computation of hp requirement - optimum machinery and Replacement criteria; Break-even analysis, reliability and cash flow problems

UNIT IV **8 Hours**

FARM MACHINERY OPERATION AND MANAGEMENT

Operations and adjustments of Land preparation , planting, intercultural, plant protection and harvesting machinery-management of machinery

UNIT V **9 Hours**

CUSTOM HIRING MODELS

Establishment of CHC-operationalization - Custom hiring models - case studies of custom hiring- Custom hiring project formulation - ownership vs custom hiring services - Economic viability of custom hiring service units - Replacement of farm machinery

FOR FURTHER READING

Case studies on farm management systems

Total: 45 Hours

Reference(s)

1. Mahajan M .Industrial Engineering and Production Management Dhanpet Rai and Co(P) Ltd. New Delhi. 2001
2. . Sharma D N and S.Mukesh. Farm Power and Machinery Management, Jain Brothers, New Delhi.2013.
3. Farm Tools and Equipment's for Agriculture, authored by: Surendra Singh, 2016
4. A Textbook of Farm Machinery and Equipment: Principles and Practice Paperback, by T. Senthilkumar (Author), B. Suthakar (Author), G. Manikandan (Author), 2023
5. https://www.researchgate.net/publication/323771721_Farm_Machinery_and_Equipment-I_Practical_Manual

22AG005 HYDRAULIC DRIVES AND CONTROLS 3 0 0 3

Course Objectives

- To assess the application of hydraulics in agricultural machinery
- To design drives and controls agricultural machinery, equipment, and implements
- To know about the safety in design and operation of hydraulic drives

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector

Course Outcomes (COs)

1. Implement hydraulic fundamentals in the design of hydraulic systems and controls.
2. Design pumps for hydraulic systems in agricultural machinery applications.
3. Develop accumulators and hydraulic circuits for efficient power transmission.
4. Select appropriate valves and construct valve circuit diagrams for troubleshooting.
5. Ensure compliance with safety standards in hydraulic system operations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	3		-	-	-	-	-	-	-	3	-	-
2	2	2	3	2	1	-	1	-	-	-	-	-	2	-	-
3	2	2	3	1	1	-	-	-	-	-	-	-	2	-	1
4	2	2	3	2	2	1	-	-	-	-	-	-	2	-	2
5	2	2	1	3	1	1	1	3	-	-	-	-	2	-	2

UNIT I **9 Hours**

INTRODUCTION

Hydraulic Basics- Pascal"s Law, Flow, Energy, Work, and Power. Hydraulic Systems, Color Coding, Reservoirs, Strainers and Filters, Filtering Material and Elements.

UNIT II **9 Hours**

PUMPS

Pump Classifications, operation, performance, Displacement, Design of Gear Pumps, Vane Pumps, Piston Pumps.

UNIT III **9 Hours**

ACCUMULATORS, AND CIRCUITS

Accumulators, Pressure Gauges and Volume Meters, Hydraulic Circuit, Fittings and Connectors. Hydraulic Actuators, Cylinders, Construction and Applications, Maintenance, Hydraulic Motors.

UNIT IV **9 Hours**

VALVES

Valves, Pressure-Control Valves, Directional- Control Valves, Flow-Control Valves, Valve. Installation, Valve Failures and Remedies, Valve Assembly, Troubleshooting of Valves- Hydraulic Circuit Diagrams and Troubleshooting

UNIT V **9 Hours**

SAFETY AND CONTROLS

United States of American Standards Institute (USASI) Graphical Symbols Tractor hydraulics, nudging system, ADDC. Pneumatics: Air services, logic units, Fail safe and safety systems Robotics: Application of Hydraulics and Pneumatics drives in agricultural systems, Programmable Logic Controls (PLCs)

Total: 45 Hours

Reference(s)

1. Manring, N. D. Hydraulic Control Systems: Design and Analysis of Their Dynamics. CRC Press.2001
2. Watanabe, K. Hydraulic Proportional and Servo Control Systems. CRC Press. 2003
3. Sivaraman, I. Introduction to Hydraulics and Pneumatics. CRC Press. 2015
4. Eaton Corporation. Industrial Hydraulics Manual. Eaton Corporation. 2011
5. Daines, J. R., & Nelson, C. A. Fluid Power: Hydraulics and Pneumatics. Prentice Hall. 1991

22AG006 PRECISION FARMING EQUIPMENT 3 0 0 3

Course Objectives

- To learn about the fundamentals of precision farming principles and application of precision farming equipment
- To practice precision farming technologies for crop cultivation

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO11: 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.
PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector

Course Outcomes (COs)

1. Examine the role of sensors and electronics in advancing precision farming technologies
2. Assess the functionality of sensors, microcontrollers, and actuators in precision farming equipment
3. Apply precision farming techniques and modern machinery for enhanced agricultural productivity.
4. Implement site-specific management systems to optimize resource utilization in farming.
5. Analyze the integration of unmanned vehicles and IoT in automated farm operations.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	2	2	2	3	2	1	1	-	-	-	-	-	1	-	1
2	2	3	2	3	2	1	1	-	-	-	-	1	1	-	1
3	2	2	3	2	3	1	1	1	-	-	-	-	3	-	3
4	1	2	3	2	3	1	1	-	-	-	1	-	2	-	2
5	1	3	3	2	3	1	1	1	1	-	-	-	2	-	3

UNIT I **8 Hours**

ROLE OF ELECTRONICS IN AGRICULTURAL ENGINEERING

Electronics in precision agriculture- Basics of precision agriculture - tools for implementation of precision agriculture. Introduction of GIS/GPS positioning system for precision farming. Use of GIS and GPS in farm machinery and equipment.

UNIT II **10 Hours**

SENSORS, MICROCONTROLLER AND ACTUATOR FOR PRECISION AGRICULTURE

Types of sensor- principle and concept of different sensor like ultrasonic, proximity, PIR, IR, radar, pressure, gas, temperature, moisture, strain /weight, colour sensor etc. used in agriculture. Microcontroller: Arduino, Raspberry Pi and PLC Actuator : DC Motor, Pump, linear Actuator etc. - Basic input circuits and signal conditioning systems - amplifiers and filters.

UNIT III **9 Hours**

PRECISION FARMING CONCEPTS AND PRECISION FARMING MACHINERY

Precision farming concepts-Map based system- Real time system - Combination Map and real time system -components of PF - Site specific management- Constraints of PF-Precision tillage, planting, intercultural, plant protection and harvesting equipment, laser guided leveller, power sprayer, straw chopper cum spreader, straw bailer, combine harvester.

UNIT IV **9 Hours**

SITE-SPECIFIC MANAGEMENT SYSTEM

Site-specific nutrient management- weeds management- Agro-chemicals and fertilizer management, data sources and decision making for site-specific management. Grain quality and yield. Yield monitoring and mapping, soil sampling and analysis.

UNIT V **9 Hours**

UNMANNED VEHICLES AND IOT IN AGRICULTURE

UAV - Drones- Types - applications - rules and regulations - Autonomous ground vehicles - Robotic platforms and unmanned agricultural vehicles- IoT - crop yield estimates-threat identification- crop insurance-pesticides spraying, environmental monitoring- protected cultivation- food quality monitoring

FOR FURTHER READING

Case studies on precision farming practices and equipment

Total: 45 Hours

Reference(s)

1. Brase, T.A. Precision Agriculture. Thomson Delmar Learning, New York.2006
2. Hermann, J.H. Precision in Crop Farming, Site Specific Concepts and Sensing Methods: Applications and Results. Springer, Netherlands.2013.
3. Krishna, K. R. Push Button Agriculture Robotics, Drones, Satellite-Guided Soil and Crop Management. Apple Academic Press. 2016
4. Srivastava,A K., Carroll E.G., Roger P. R. and Dennis R.B. Engineering Principles of Agricultural Machines. American Society of Agricultural and Biological Engineers, USA.2006.
5. Zhang, Q. Precision Agriculture Technology for Crop Farming. CRC Press, New York.2015
6. Kepner, R.A., Bainer, R. and Berger, E.L. Principles of Farm Machinery.AVI Publ. 1978.

22AG007 BUILDING MATERIALS, ESTIMATION AND COSTING

3 0 0 3

Course Objectives

- To understand the fundamental knowledge on different building materials
- To impart knowledge on design of different aspects of building construction
- To learn to prepare detailed estimate and cost estimate of buildings

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector

Course Outcomes (COs)

1. Classify rocks, bricks and clay products based on their characteristics and examine the manufacturing process of bricks including moulding, drying and burning for its properties
2. Assess the natural resources of lime, its types and timber qualities and test for water cement ratio in manufacturing Portland cement.
3. Organize foundation, stone masonry and brick masonry and compare stone masonry and brick masonry
4. Construct the buildings by considering dampness, mortar, foundation and concrete
5. Find the cost estimate based on the public works department schedule rates

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	1	-	-	1	-	-	-	-	-	-	-	2
2	2	1	-	2	-	-	1	-	-	-	-	-	-	-	2
3	1	2	2	1	-	-	3	-	-	-	-	-	-	-	3
4	1	2	3	-	-	-	1	-	-	-	-	-	-	-	3
5	2	2	2	-	-	-	1	-	-	-	-	-	-	-	3

UNIT I **9 Hours**

CONSTRUCTION MATERIALS

Classification of rocks - Characteristics of Stones -Testing of Stones-Manufacture of Bricks - Moulding - Drying and Burning of bricks-Properties of good Brick -Classification of bricks -Clay Products- Ceramics - Tiles - Earthenware and Stoneware and uses

UNIT II **8 Hours**

LIME AND CEMENT

Lime- Natural Sources -Types of lime - Calcination-Cement -Raw materials - Water Cement Ratio. Manufacture of Portland Cement Wet and Dry process-Standard Specifications- Storage of cement-Timber - Definition - Defects in timber-Qualities of good timber

UNIT III **9 Hours**

BRICK, STONE MASONRY AND FOUNDATION

Concept of Foundation -Factors affecting Selection of Foundations -Types of soils-Subsurface Investigations -Bearing Capacity of soil -Testing & Improving Bearing Capacity of soil- Types of Foundations-Piles -Foundation in Black Cotton soil-Site Selection - General principles - classification of brick masonry-precautions in brick masonry -Stone Masonry -Comparison between Brick and Stone Masonry -Classification -General Principles and precautions in stone masonry

UNIT IV **10 Hours**

BUILDING CONSTRUCTION

Walls -Classification of walls - Dampness -Causes of Dampness -Methods of Preventing Dampness - Damp Proofing materials - Methods of providing Damp Proofing Materials-Mortars -Functions and Types of mortars -Concrete -Characteristics -Types and uses - Cube Strength of Concrete-Roofs - Classification - Floors -Types of Floor-Types of Plastering and Pointing -Painting and Distempering

UNIT V **9 Hours**

ESTIMATING AND COSTING

PWD schedule of rates - data sheet - detailed estimate - abstract estimate - preparation of estimate market rate estimation

FOR FURTHER READING

Estimating and costing of farm structures- irrigation systems- farm ponds- poultry shed- dairy barn

Total: 45 Hours

Reference(s)

1. B.N. Datta, Estimation and costing. Published by the Author, Tagore Palli, Motilal Bose road, Lucknow, 2002
2. S.C Rangwala, Estimating and costing, Charotar book stall, Station road, Anand, 1991.
3. N.L. Arora and B.R. Gupta, Building construction. Sathyaprakasham, 16/7698, New market, New Rohtak road, New Delhi -5, 1995
4. B.L. Handoo and V.M. Mahajan, Civil engineering materials. Sathyaprakasam, 16/7698, New market, New Rohtak road, New Delhi-5, 1995
5. S.C. Rangwala, Building construction, Charotar publishing house, Anand, 2000
6. S.V Deodhar and Singhal, Civil engineering materials. Khanna publishers, 2B, Nath market, Naisark, Delhi - 2001

22AG008 GROUNDWATER, WELLS AND PUMPS **3 0 0 3**

Course Objectives

- To provide students with an understanding of the principles of groundwater and its behavior
- To introduce the methods and technologies used in groundwater exploration, development, and management
- To familiarize students with the design and installation of wells and pumping systems

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector

Course Outcomes (COs)

1. Execute the assessment of water resources and availability of groundwater in a given area
2. Analyze the design and construction features of wells for accessing groundwater
3. Evaluate the systemic and operating characteristics of hydraulic pumps for groundwater extraction
4. Evaluate the water quality standards and strategies for protecting groundwater resources
5. Evaluate various sustainable management practices for groundwater resources

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	3	-	2	-	-	-	-	-	-	-	-	-	-	2
2	1	2	3	-	-	-	-	-	-	-	-	-	-	-	2
3	1	2	3	-	-	-	-	-	-	-	-	-	-	-	1
4	1	3	-	2	-	-	2	-	-	-	-	-	-	-	2
5	-	1	2	-	-	2	-	3	-	-	-	-	-	-	2

UNIT I **9 Hours**

INTRODUCTION TO GROUNDWATER RESOURCES

Sources and availability of groundwater, groundwater exploration methods, hydrologic cycle and water budget, water quality parameters and their significance, water scarcity issues and solutions

UNIT II **8 Hours**

WELLS

Types of wells, design principles and construction methods, borehole logging and interpretation, well development, well rehabilitation, wellhead protection, well maintenance and troubleshooting

UNIT III **9 Hours**

PUMPS

Types of pumps and their selection criteria, operating characteristics and performance evaluation, pump installation and operation, energy efficiency of pumps, pump maintenance and troubleshooting

UNIT IV **9 Hours**

GROUNDWATER QUALITY

Parameters affecting water quality, water quality standards and guidelines, water quality testing methods, interpretation of water quality data, water treatment options, safe use and disposal of water

UNIT V **10 Hours**

SUSTAINABLE GROUNDWATER MANAGEMENT

Groundwater management principles, groundwater monitoring and modeling, groundwater recharge techniques, conjunctive use of surface and groundwater resources, integrated water resources management, policies and regulations for sustainable groundwater management

FOR FURTHER READING

Estimating and costing of farm structures- irrigation systems- farm ponds- poultry shed- dairy barn

Total: 45 Hours

Reference(s)

1. David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007
2. Bhagu R. Chahar, Groundwater Hydrology, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017
3. Subramanya K, Fluid Mechanics and Hydraulic Machines: Problems and Solutions, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2018.
4. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014

22AG009 PROTECTED CULTIVATION 3 0 0 3

Course Objectives

- To impart knowledge on the protected cultivation of vegetables, fruits and flower crops
- To sensitize the students on hi-tech production technology of fruits and vegetables and flower crops
- To learn and practices the various production practices of flower and other high value crops

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector

Course Outcomes (COs)

1. Execute different methods of protected cultivation practices available for vegetable crops and flowers
2. Implement the technologies available for protected cultivation of vegetable crops
3. Implement the technologies available for protected cultivation of flower crops
4. Analyze different precision farming techniques using sensors and geographic information systems for the suitability of crops
5. Evaluate the suitability of various precision farming technologies available for horticulture crops

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	3	1	2							1	2		
2	2	3	3	1	2							2	1	1	
3	2	2	2	1	2							1	1	1	
4	2	3	3	1	2							1	2		1
5	2	2	3	1	2							1	2	1	

UNIT I **9 Hours**

PROTECTED CULTIVATION AND ITS TYPES

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

UNIT II **9 Hours**

PROTECTED CULTIVATION OF VEGETABLE CROPS

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

UNIT III **9 Hours**

PROTECTED CULTIVATION OF FLOWER CROPS

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

UNIT IV **9 Hours**

PRECISION FARMING TECHNIQUES

Concept and introduction of precision Farming: importance, definition, principles and concepts. Role of GIS and GPS. Mobile mapping system and its application in precision farming. Design, layout and installation of drip and fertigation in horticultural crops, role of commuters in developing comprehensive systems needed in site specific management (SSM), georeferencing and photometric correction.

UNIT V **9 Hours**

PRECISION FARMING OF CROPS

Sensors for information gathering, geostatistics, robotics in horticulture, postharvest process management (PPM), remote sensing, information and data management and crop growth models, GIS based modeling,VRT, robotics and drones in agriculture Precision farming techniques for horticultural crops: Precision farming techniques for tomato, chilli, bhendi, bitter gourd, bottle gourd, cauliflower, cabbage, grapes, banana, rose, jasmine, chrysanthemum, marigold, tuberose, china aster, turmeric, coriander, coleus and gloriosa.

FOR FURTHER READING

Design of greenhouse roof trusses, sorting, grading and packing of fruits, vegetables and flowers, and their transportation to market.

Total: 45 Hours

Reference(s)

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

22AG010 DESIGN OF MICRO IRRIGATION SYSTEMS   3 0 0 3

Course Objectives

- To understand the basic concepts, tools, and skills used to deliver water efficiently and effectively on both a field and garden scale efficiency
- To learn about the role of irrigation water in agriculture, and the environmental factors that influence the type, frequency, and duration of irrigation
- To learn about the resources and essential skills needed to determine the proper timing and volume of irrigation, using both qualitative and quantitative methods

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector

Course Outcomes (COs)

1. Implement the classification of different types of pumps and water lifting devices based on the principle, components, and working efficiency
2. Execute the working principle of centrifugal pump as well as its characteristics with efficiencies to design a centrifugal pump including impeller design, casing and other parts of pumps
3. Analyze the water budgets and hydraulics used to develop irrigation schedules through micro-irrigation based on cropping systems
4. Analyze the design protocols for drip and sprinkler irrigation systems including, main line, sub main and laterals by considering the pump capacity
5. Evaluate the selection of components and design considerations of greenhouse irrigation system and advanced irrigation systems with automation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	2	2	1	1	-	-	-	-	1	-	-	2
2	2	2	3	2	2	1	1	-	-	-	-	2	-	-	2
3	2	2	3	2	2	1	1	-	-	-	-	1	-	-	2
4	2	2	3	3	2	1	1	-	-	-	-	1	-	-	3
5	2	2	3	2	2	1	1	-	-	-	-	1	-	-	3

UNIT I **10 Hours**

TYPES OF IRRIGATION PUMPS

Classification of pumps - definitions and terminology. Positive displacement pumps - reciprocating pump, principle, components, single acting and double acting, work done, coefficient of discharge, slip. Centrifugal pump - classification - priming - cavitation - net positive suction head, work done by centrifugal pump. Pump characteristics - system curves and operating curves - pump efficiencies - selection of pumps - installation, operating troubles and remedies.

UNIT II **10 Hours**

BASICS OF MICRO-IRRIGATION AND WATER BUDGETING

Concepts of soil water - evapotranspiration - measurement - estimation of crop water requirement - irrigation water requirement. Irrigation scheduling - irrigation efficiency - water budgeting. Irrigation water quality - regulatory standards - monitoring system.

UNIT III **8 Hours**

DRIP IRRIGATION DESIGN

Components of drip irrigation - hydraulics of drip irrigation - design and performance assessment of filters - wetting pattern - design of irrigation layout - operation and maintenance.

UNIT IV **8 Hours**

SPRINKLER IRRIGATION DESIGN

Components of sprinkler irrigation - hydraulics - uniformity and efficiency of sprinkler systems. Features of sprinkler discharge - distance of throw - distribution pattern - application rate - droplet size. Design of sprinkler systems - mains - laterals - sprinkler heads - layout. Sprinkler selection and spacing - capacity of sprinkler system. Operation and maintenance of the sprinkler irrigation system.

UNIT V **9 Hours**

SPECIAL TOPICS IN MICRO-IRRIGATION

Greenhouse irrigation - selection of components - design considerations. Automated irrigation - selection of system and components - decision support systems - IoT in micro-irrigation. Fertigation - selection of components - design considerations - automation. Economics of micro-irrigation - project cost estimation - cost-benefit analysis - alternate energy for micro-irrigation - adaptive mulching techniques

FOR FURTHER READING

Guidelines on micro-irrigation installation - government schemes and budgeting plans - preparation of project proposal for the installation and commissioning of irrigation systems

Total: 45 Hours

Reference(s)

1. V.Ravikumar and M.V.Ranghaswami, Micro irrigation and irrigation pumps. Kalyani Publishers, Ludhiana. 2011
2. Jack Keller and Rond Belisher, Sprinkler and Trickle irrigation, Van Nostrand Reinhold, New York, 1990
3. I.J. Kavassik, Engineers Guide to Centrifugal pumps, McGraw Hill Book Company, 1964
4. A.M.Michael, Irrigation theory and practice, Vikas publishers, New Delhi, 2010
5. L.J. James, Farm Irrigation System Design, John Wiley & Sons, 1988

22AG011 WATERSHED PLANNING AND MANAGEMENT

3 0 0 3

Course Objectives

- To acquire knowledge about the principles of watershed development activities
- To understand the hydrological responses of a watershed and its control measures
- To investigate the applicability of hydrological models for watershed conservation

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector

Course Outcomes (COs)

1. Analyze the watershed characteristics for classification and prioritization of resources
2. Execute the watershed planning activities based on the inventory and scope
3. Evaluate the needs, methods and implementation strategies of watershed management projects
4. Evaluate the watershed responses for suggesting suitable control measures
5. Execute the selection of hydrologic models for watershed management

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	-	-	-	3	3	-	-	-	-	-	-	-	3
2	2	-	-	-	-	3	3	-	-	-	-	-	-	-	3
3	-	2	1	-	-	2	3	-	-	-	-	-	-	-	3
4	1	2	2	-	-	3	2	-	-	-	-	-	-	-	3
5	2	2	1	-	2	-	3	-	-	-	-	-	-	-	3

UNIT I **9 Hours**

WATERSHED CHARACTERISTICS

Watershed-Concept and objectives - watershed classifications - land use and capabilities - watershed delineation - toposheets - codification - watershed priorities - Indian scenario - watershed issues

UNIT II **9 Hours**

WATERSHED PLANNING

Watershed resources inventory - land use data - hydrologic data - planning principles - watershed development plan - planning process - scope and objectives - step wise process - implementation strategy - monitoring and evaluation system

UNIT III **9 Hours**

WATERSHED MANAGEMENT

Project proposal formulation - action plan - watershed economics - runoff management - temporary and permanent soil conservation structures - water conservation practices - participatory watershed management - watershed based rural development - national programmes on watershed management - Government of India guidelines

UNIT IV **9 Hours**

WATERSHED RESPONSES

Estimation of water yield - analysis of overland flow and rain water harvesting - assessment and management perspectives - development of recharge structures - estimation of soil erosion - measyrement and controls - estimation of sediment yield - measurement and controls - watershed prioritization - index based models - morphometric analysis

UNIT V **9 Hours**

WATERSHED MODELS

Hydrologic modelling - basic principles - objectives and scope - classification of watersheds models - empirical - conceptual - physical based - selection of watershed model - suitability - model assessment - sensitivity analysis - major watershed models - governing equations - software tools - working principles - exercises to expertise

FOR FURTHER READING

GIS for watershed management; Case studies in watershed development projects; decision support system for watershed management

Total: 45 Hours

Reference(s)

1. Ghanashyam Das, Hydrology and Soil Conservation engineering, Prentice Hall of India Private Limited, New Delhi, 2000
2. Suresh R, Land and water management principles, Standard Publishers & Distributors, New Delhi, 2008
3. K. Palanisami, V. N. Sharda and D. V. Singh, Water management in the Hill regions-Evidences from field studies. Bloomsbury Publishing India Pvt. Ltd, 2013
4. Das M, Saikia MD, Watershed management, PHI Learning, 2013
5. Brooks KN, Ffolliott PF, Magner JA, Hydrology and the Management of Watersheds, Wiley-Blackwell, Ames, IA, USA, 2013

22AG012 RESERVOIR AND FARM POND DESIGN 3 0 0 3

Course Objectives

- To acquire knowledge about water harvesting structures and their design
- To understand the design aspects of reservoirs and farm ponds
- To infer the design, operation and maintenance of reservoirs and farm ponds

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector

Course Outcomes (COs)

1. Analyze the hydrological and watershed concepts of reservoirs and farm ponds
2. Execute the design of reservoirs, embankment ponds and excavation ponds
3. Analyze the seepage discharge and its impacts on stability aspects of the dams
4. Evaluate the constructional, operational and maintenance aspects of reservoirs and farm ponds
5. Evaluate the economic indicators for the cost-benefit analysis of water harvesting projects

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	2	2	-	-	-	1	-	-	-	-	-	-	-	3
2	2	1	3	-	-	-	2	-	-	-	-	-	-	-	3
3	2	2	3	-	-	-	2	-	-	-	-	-	-	-	3
4	-	2	3	-	-	2	2	-	-	-	-	-	-	-	3
5	-	3	2	-	-	2	3	-	-	-	-	-	-	-	3

UNIT I **9 Hours**

FUNDAMENTALS OF RESERVOIR AND FARM PONDS

Water harvesting - hydrological aspects - watershed aspects - topographical aspects for location - General considerations - drainage area - pond capacity - landscape evaluation - reservoir dam - classification - selection criteria - farm ponds - classification - design criteria

UNIT II **9 Hours**

DESIGN ASPECTS OF RESERVOIR AND FARM POND

Earthen embankments - functions - advantages and disadvantages -classification - hydraulic fill and rolled fill dams - basic design concepts - site selection - foundation requirements - grouting -harvesting principles - components - catchment and reservoir yield - estimating storm runoff - design catchment yield - dependable flow - excavated ponds -soils investigation - spillway and inlet requirements - planning and construction

UNIT III **9 Hours**

SEEPAGE AND STABILITY ANALYSIS

Estimation of seepage discharge - location of seepage line - graphical and analytical methods -flow net and its properties - seepage pressure - seepage line in composite earth embankments - drainage filters - piping and its causes - drainage system for seepage control - stability of slopes - analysis of failure by slice method - stability of earthen embankments against failure by tension, overturning, sliding - Slope protection

UNIT IV **9 Hours**

CONSTRUCTION OF EARTHEN DAM

Earthen dam - staking for construction - construction methods and specifications - considerations in implementation - checking with compliance standards - sealing methods -considerations in maintenance - monitoring evaluation and protection - extension and training - miscellaneous aspects - water quality considerations - seepage and evaporation reduction measures - runoff inducement methods

UNIT V **9 Hours**

ECONOMIC ANALYSIS OF FARM POND AND RESERVOIR

Estimation of earthwork - cost analysis - initial investment - variable cost - annual returns - present worth analysis - economic indicators - net present value - benefit cost ratio - internal rate of return - Payback period

FOR FURTHER READING

Other water harvesting structures - Appurtenant structures - design of dam components

Total: 45 Hours

Reference(s)

1. Murthy, V.V.N. and Jha. M. K. (2011). Land and Water Management Engineering. Kalyani Publication.
2. Garg, S. K. (2011). Irrigation Engineering and Hydraulic Structures. Khanna Publishers
3. Theib YO, Dieter P, Ahmed YH, Rainwater Harvesting
4. Agriculture in the Dry Areas, CRC Press, Taylor and Francis Group, London, 2012
5. Suresh R, Soil and Water Conservation Engineering, Standard Publisher Distributors, New Delhi, 2014

22AG045 WATER HARVESTING TECHNIQUES 3 0 0 3

Course Objectives

- To enhance the awareness about water resources management and conservation
- To acquire knowledge about water harvesting techniques and their implementation
- To practice the design aspects of sustainable rainwater harvesting solutions for communities

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Apply the basic concepts of global water balancing to assess the water availability and conservation challenges
2. Execute the principles of water harvesting techniques to compare different rainwater harvesting systems
3. Analyze various water harvesting techniques based on source, storage and use
4. Analyze the scope and features of flood water and groundwater for their optimal harvesting
5. Evaluate the design aspects of various surface and subsurface water harvesting systems

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	2	2	2	2	-	-	-	-	-	-	-	-	2	-
2	2	2	2	2	2	-	-	-	-	-	-	-	-	2	-
3	3	2	3	2	2	-	-	-	-	-	-	-	-	1	-
4	4	3	2	2	2	-	-	-	-	-	-	-	-	2	-
5	5	3	2	3	3	-	-	-	-	-	-	-	-	1	-

UNIT I 9 Hours
WATER RESOURCES AND CHALLENGES
Global water distribution – primary and secondary sources of water – technical social and cultural aspects. Global challenges in water and climate – water scarcity – water pollution – Indian scenario. Watershed – water resources management – public participation – integrated approach. Water governance – water sharing plans – policy, schemes and concerns.

UNIT II **9 Hours**
WATER HARVESTING CONCEPTS
Principles of water harvesting – collection at micro and macro levels, flow control, storage and uses. Rainwater harvesting systems – traditional and contemporary – groundwater recharge. Water resources inventory – site analysis – database collection – water allocation principles based on demand and supply. Traditional water harvesting systems – practices in India – references in old texts – reasons for their deterioration – way forward.

UNIT III **9 Hours**
WATER HARVESTING TECHNIQUES
Water harvesting principles for rural and urban – classification based on source, storage and use. Short-term and micro-level harvesting techniques for runoff – terracing and bunding – rock and ground catchments. Long-term and macro-level harvesting techniques for runoff – farm ponds – percolation ponds and nala bunds. Design considerations – site selection – selection of system and components – cost estimation – optimization for sustainable operation.

UNIT IV **9 Hours**
FLOOD WATER AND GROUNDWATER HARVESTING
Floods – causes of urban floods and droughts – characteristics of water spread – impacts. Flood water harvesting – permeable rock dams – water spreading bunds – flood control reservoir. Groundwater harvesting – aquifer characteristics – subsurface techniques – infiltration wells – recharge wells – groundwater dams – managed aquifer recharge. Watershed-based approach – project planning at micro and macro levels – community participation – rain centers

UNIT V **9 Hours**
DESIGN ASPECTS OF WATER HARVESTING SYSTEMS
Estimation of water availability – selection of runoff coefficients – computation of rainwater runoff volume – hydrograph analysis. Design of drainage system – types – design criteria – filter design – causes of failures. Design of storage structures – storage capacity – selection of component – methods of construction. Trenching and Diversion Structures – types – site selection – design criteria – most economic section – design consideration of ditch system.

FOR FURTHER READING
Global history of RWH – water sharing policy – water quality management – construction materials and processes – project on designing a RWH system for a residential complex, factory, college, any other institution – field visit

Total: 45 Hours

Reference(s)

1. Theib YO, Dieter P, Ahmed YH, Rainwater Harvesting for Agriculture in the Dry Areas, CRC Press, Taylor and Francis Group, London, 2012.
2. Lancaster, Brad. Rainwater Harvesting for Drylands and Beyond, Volume 1, 3 rd edition, Rain source Press. 2019.
3. Das M, Open Channel Flow, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
4. Michael AM, Ojha TP, Principles of Agricultural Engineering, Volume II, 4th Edition, Jain Brothers, New Delhi, 2003.
5. Suresh R, Soil and Water Conservation Engineering, Standard Publisher Distributors, New Delhi,2014.

22AG013 REFRIGERATION AND COLD STORAGE 3 0 0 3

Course Objectives

- To interpret principles of operation of different Refrigeration & Air conditioning systems
- To understand the types of compressors and expansion devices and their applications
- To combine the parameters involved in design of the various air conditioning systems

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector

Course Outcomes (COs)

1. Execute the principles and practice of thermal comfort
2. Analyse the vapor compression and heat-driven refrigeration systems
3. Apply knowledge on psychrometric chart for designing heating and refrigeration units
4. Find various types of air conditioning systems and their application in food industry
5. Evaluate applications and make design calculations of Heating, Ventilation and Air conditioning systems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	1	1	-	-	-	-	-	-	-	1	1	1
2	1	2	2	2	1	-	-	-	-	-	-	-	-	1	1
3	2	3	2	1	1	-	-	-	-	-	-	-	1	1	1
4	1	3	2	2	1	-	-	-	-	-	-	-	3	1	1
5	2	2	3	1	1	-	-	-	-	-	-	-	2	2	2

UNIT I **10 Hours**

REFRIGERATION PRINCIPLES AND COMPONENTS

Regrigeration principles - refrigeration effect coefficient of performance units of refrigertaion - refrigeration components - compressor - classification - principle and working - condensors - types - construction principle and working - refrigerants properties classification comparison and advantages - effect on environmental pollution

UNIT II **8 Hours**

VAPOUR COMPRESSION AND VAPOUR ABSORPTION CYCLE

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

UNIT III **9 Hours**

APPLIED PSYCHROMETRY

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

UNIT IV **8 Hours**

AIR CONDITIONING SYSTEM

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

UNIT V **10 Hours**

APPLICATIONS OF REFRIGERATION IN FOOD PROCESSING AND PRESERVATION

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

Total: 45 Hours

Reference(s)

1. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill Publishing Company Private Limited, New Delhi, 2008
2. Langley and C. Billy, Refrigeration and Air conditioning, Ed. 3, Engle wood Cliffs (NJ), Prentice Hall of India, New Delhi, 2009
3. Roy J. Dossat, Principles of Refrigeration, Pearson Education, New Delhi, 2007
4. N. F Stoecker and Jones, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 2008
5. Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Ltd., 2007
6. 6. J. B Hains, Automatic Control of Heating & Air conditioning, Tata McGraw Hill Publishing Company Private Limited, 2005

22AG014 FRUITS AND VEGETABLES PROCESSING 3 0 0 3

Course Objectives

- Implement specific post harvest handling technique for storage and transport of fruits and vegetables
- Apply preservation techniques to produce value added fruits and vegetable products
- Learn the industrial scale processing and preservation methods to extend the shelf life of fruit and vegetable commodities

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4: 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.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Apply post-harvest physiology principles to design optimal fruit and vegetable storage strategies
2. Apply preservation methods to develop value-added fruit and vegetable products
3. Analyze drying and dehydration techniques to design efficient preservation processes
4. Apply minimal processing and fermentation principles to develop novel food products
5. Apply canning and bottling principles to design safe and effective preservation systems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	2	-	-	-	-	-	-	-	2	-
2	2	-	-	2	-	-	-	-	-	-	-	-	-	2	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
4	2	1	-	2	-	-	-	-	-	-	-	-	-	1	-
5	2	-	-	2	-	-	-	-	-	-	-	-	-	1	-

UNIT I **9 Hours**

HARVESTING, HANDLING AND STORAGE OF FRUITS AND VEGETABLES

Fruits and vegetables- classification- nutritional profile - Harvesting of fruits and vegetables - maturity indices - post harvest physiology - handling - precooling and storage - Storage under ambient condition- low temperature storage - chilling, frozen storage- chilling injury- freeze burn- Controlled atmosphere storag- Modified atmosphere storage - concepts and methods - gas composition - Changes during storage

UNIT II **9 Hours**

PRESERVATION OF FRUITS AND VEGETABLES BY VALUE ADDITION

Methods of fruit and vegetable preservation - Processing using sugar- Preparation of jam- jelly- marmalade- squash- RTS- crush- nectar- cordial- fruit bar- preserves- candies and carbonated- fruit beverages- Processing using salt - Brining - Preparation of pickles- chutney and sauces, ketchup- Machinery involved in processing of fruits and vegetables products

UNIT III **9 Hours**

PRESERVATION BY DRYING AND DEHYDRATION

Drying and dehydration - Types of driers - Solar- cabinet- fluidized bed drier-spouted bed drier- heat pump drier- vacuum drier and freeze drier - Applications- Preparation of product- Changes during drying and dehydration- Problems related to storage of dried and dehydrated products

UNIT IV **9 Hours**

MINIMAL PROCESSING AND FERMENTATION

Primary processing and pack house handling of fruits and vegetables; Peeling, slicing- cubing- cutting and other size reduction operations for fruits and vegetables- Minimal Processing of Fruits and Vegetables- Preservation by fermentation - wine- vinegar- cider and sauerkraut

UNIT V **9 Hours**

CANNING AND BOTTLING

Canning - principles- types of cans - preparation of canned products - packing of canned products - spoilage of canned foods- Bottling of fruit and vegetable- Precautions in canning operations- General considerations in establishing a commercial fruit and vegetable cannery- machineries involved in canning and bottling unit

FOR FURTHER READING

Toping of sugar/salt- Hybrid drier- safe level of irradiation- solid state fermentation- layout of fruit/vegetable canning unit

Total: 45 Hours

Reference(s)

1. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Third Edition, CBS Publishers & Distributors-New Delhi, 2002
2. A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003
3. Girdhari Lal, G. S.Siddappa and G.L. Tandon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 2009
4. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995
5. K.Sharma, Stevan J.Mulvaney and Syed S.H. Rizvi, Food Process Engineering-Theory and Laboratory equipments, John Wiley & Sons, New York, 2000

22AG015 STORAGE AND PACKAGING TECHNOLOGY **3 0 0 3**

Course Objectives

- To study about the different storage structures
- To learn about the different packaging materials and various methods of packaging to improve the shelf life of the products
- To understand the concepts of Controlled Atmosphere Storage and Modified Atmosphere Packaging
- To learn about the equipment used for packaging

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging

Course Outcomes (COs)

1. Analyze storage environments and structures to design effective food preservation systems
2. Apply packaging principles to select appropriate materials and evaluate shelf life
3. Analyze controlled and modified atmosphere packaging to design optimal storage conditions
4. Apply canning principles to design safe and effective preservation processes for various foods
5. Analyze flexible film packaging and design appropriate solutions for diverse food products

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	2	2	-	-	-	1	-	-	-	-	-	-	-	3	-
2	2	2	3	-	-	1	-	-	-	-	-	-	-	3	-
3	2	2	3	-	-	1	-	-	-	-	-	-	-	3	-
4	2	2	3	1	-	1	-	-	-	-	-	-	-	3	-
5	2	3	2	-	-	-	-	-	-	-	-	-	-	3	-

UNIT I **11 Hours**

STORAGE ENVIRONMENT AND STORAGE STRUCTURES

Factors affecting shelf life of food material during storage- Interactions of spoilage agents with environmental factors as water- oxygen- light- pH and general principles of control of the spoilage agents- Difference between food infection- food intoxication and allergy. Fumigation Processes for bag storage piles- Rural storage structures- Bag Storage and its Design- Parameters and types of storage structure- Bulk Storage in silos and large Bins Construction of Silos- Problems of Silo storage- relative Costs of Silo and Bag Storage- Quality Changes and remedial measures of Grains during storages- Design considerations and heat load calculation of cold storage

UNIT II **7 Hours**

INTRODUCTION TO PACKAGING

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

UNIT III **10 Hours**

CONTROLLED ATMOSPHERE STORAGE AND MODIFIED ATMOSPHERE PACKAGING

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

UNIT IV **10 Hours**

CANNING

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

UNIT V **7 Hours**

FLEXIBLE FILMS PACKAGING

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

FOR FURTHER READING

Active packaging and Oxygen scavenging- applications of Modified atmosphere packaging- Vacuum and Inert Gas Packaging- Transport systems or technology for CAS and MAP

Total: 45 Hours

Reference(s)

1. Samuel Matz, The Chemistry and Technology of Cereals as Food and Feed, Chapman & Hall, 1992
2. Ruth H. Matthews: Pulses Chemistry, Technology and Nutrition Mercel Dekker Inc., USA,1989
3. Gordon L. Robertson, Food Packaging- Principles and Practice Marcel Dekker Inc, USA, 1993
4. Donald Downing, Complete Course in Canning (3 Volumes) CTI Publications Inc, USA, 1996

22AG016 FOOD SAFETY MANAGEMENT SYSTEMS 3 0 0 3

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it
- Learn common causes of foodborne illness - viz. physical, chemical and biological and identification through food analysis
- Understand food inspection procedures employed in maintaining food quality

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Analyze the sources of food spoilage and food toxicant
2. Assess the food quality evaluation methods
3. Execute the food inspection procedures to evaluate the food quality
4. Select the National and International Food laws and regulations
5. Evaluate the quality control measures in food processing industry and marketing centres

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	-	1	-	-	-	3		2	-	-	-	2	-	2	-
2	-	3	-	-	-	3	1	-	2	-	-	1	-	2	-
3	-	3	-	-	-	-	-	1	1	1	-	1	-	1	-
4	3	-	-	-	2	-	-	-	-	-	-	1	-	1	-
5	2	2	2	-	-	1	-	-	3	-	-	1	-	-	-

UNIT I **9 Hours**

FOOD SAFETY

Food safety - General principles of food safety. Characterization of food Hazards - physical, chemical and biological. Food spoilage and food borne infection hazards-sources of food spoilage and microorganisms-microbial problems in food safety-food toxicants and food poisoning - prevention. Cross contamination, Limits for pesticide and metal contamination of food. Adulteration, Food additives- types- usage, permissible limits, concept of safe food.

UNIT II **9 Hours**

FOOD QUALITY AND QUALITY EVALUATION OF FOODS

Food Quality - its need and its role in Food Industry. Food Quality and Quality Attributes-Classification of Quality Attributes and their role in food Quality. Quality Assessment of Food materials -Fruits, vegetables, cereals, legumes, dairy products, meat, poultry, egg and processed food. Sensory Evaluation of Food Quality. Requirements for conducting Sensory Evaluation, Methods of Sensory Evaluation and Evaluation cards, Different methods of Quantitative descriptive analysis.

UNIT III **9 Hours**

QUALITY CONTROL

Objectives, Importance and Functions of Quality Control, Quality control specifications, training of food technologists for quality control, implementation of standards and specifications. Quality control, principles of quality control - raw material control, process control, finished product inspection, process control, quality problems and quality improvement techniques- mechanization, future of quality control, Total quality management. Objective/Instrumental analysis of Quality Control.

UNIT IV **12 Hours**

NATIONAL AND INTERNATIONAL FOOD LAWS AND STANDARDS

Standards for food packaging and labelling - FSSAI, Bureau of Indian Standards (BIS), Agricultural Grading and Marketing (AGMARK), The Agricultural and Processed Food Product Export Development Authority (APEDA), MPEDA. Food and Drug Administration Act (FDA), International Organization for Standards (ISO) and its implication, Generally recognized as safe (GRAS), European Council (EU), Codex Alimentarius Commission (CAC), Total Quality Management (TQM), Good Manufacturing Practices (GMP), Good Agricultural Practices(GAP), and Good Hygienic Practices (GHP) , GMP, Hazard Analysis Critical Control Point (HACCP), FSMA, Legal Metrology Rules, Food Safety Standards for Organic foods, GFSi, HALAL and KOSHE.

UNIT V **6 Hours**

QUALITY CONTROL MEASURES IN INDUSTRIAL AND MARKETING CENTRES

Quality control system in storage, Quality control aspects in food industries, Importance of quality control in marketing of Food products - domestic and export markets. International standards for export and quarantine requirements for export of Agricultural and Horticultural produce

Total: 45 Hours

Reference(s)

1. Manoranjan Kalia, Food analysis and Quality control, Kalyani Publishers, Ludhiana, 2002.
2. Mehta, Rajesh and J. George, Food Safety Regulation Concerns and Trade: The Developing Country Perspective, Macmillan, 2005.
3. P.A. Luning, F. Devlieghere and R. Verhe, Safety in the agri - food chain, Wageningen Academic Publishers, Netherland, 2006.
4. Leo and M.L. Nollet, Handbook of food analysis - Methods and Instruments in applied food analysis, Marcel Dekker Inc., 2004.
5. J. Andres Vasconcellos,Quality Assurance for the Food Industry: A Practical Approach,1st Edition,2003.
6. V Ravishankar Rai, Jamuna A Bai,Food Safety and Protection 1st Edition,CRC Press,2017.

22AG017 EMERGING TECHNOLOGIES IN FOOD PROCESS ENGINEERING **3 0 0 3**

Course Objectives

- To understand the different emerging technologies in processing food
- To familiarize about the equipments used for the processing of foods by emerging technologies
- To understand about alternate thermal and non thermal processing techniques

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Assess the knowledge on application of High pressure processing and pulsed electric field processing
2. Assess the knowledge on application of pulsed electric field processing
3. Assess the knowledge on the importance of irradiation
4. Assess the knowledge on non thermal processing techniques
5. Assess the knowledge on thermal processing techniques

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	1	2	1	-	-	-	-	-	-	1	1	-
2	2	1	2	1	3	2	-	-	-	-	-	-	1	2	-
3	2	2	3	2	2	1	-	-	-	-	-	-	1	2	-
4	2	2	3	2	2	1	-	-	-	-	-	-	1	2	-
5	2	2	3	2	2	1	-	-	-	-	-	-	2	3	-

UNIT I **9 Hours**

HIGH PRESSURE PROCESSING

Principles- Mechanism and applications of high pressure processing to food systems- High pressure processing of salads- meats and sea foods- fruits and fruit products- Effect of high pressure on microorganisms- enzymes-textural and nutritional quality of foods- Other applications of high pressure processing- High Pressure Freezing-principles and equipment- types of high pressure freezing process-microbiological and enzymatic inactivation after high pressure freezing

UNIT II **8 Hours**

PULSED ELECTRIC FIELDS PROCESSING

Principles- Mechanism- PEF treatment systems- Main processing parameters- PEF technology Equipments- Applications- Mechanisms of microbial and enzyme inactivation- PEF processing of solid foods- liquid foods and beverages- Food safety aspects of pulsed electric fields

UNIT III **8 Hours**

FOOD IRRADIATION

Introduction- Fundamentals of food Irradiation- Type and sources of radiation- dosimetry- mode of action of ionizing radiation Direct and indirect effect- radiation effect on food constituents- Dose requirement for different products and regulations

UNIT IV **14 Hours**

ALTERNATIVE NON THERMAL PROCESSING TECHNIQUES

High intensity pulsed light technology- principles of PLT technology- Technological aspects of PLT-Effects of PLT technology on microorganisms and food quality- Ultrasound Processing- Principle of ultrasound- Fundamentals- Ultrasound as a processing and food preservation tool- Effect of ultra sound on properties of foods-Applications of ultrasound in microbial inactivation- assisted drying- extraction-osmotic dehydration- detection of foreign bodies-filtration and freezing- challenges in ultrasound processing. Radio frequency electric fields-Introduction- radio frequency electric fields equipment- effect of radio frequency electrical field on inactivation of microorganisms

UNIT V **6 Hours**

ALTERNATIVE THERMAL PROCESSING TECHNIQUES

Microwave heating and microwave drying- Microwaves- dielectric properties of foods- thermal properties of foods- Recent developments in microwave heating- combined microwave-vacuum drying- microwave freeze-drying-applications- Radio-frequency processing- Introduction-dielectric heating, Radio- Frequency applications for heating and drying

FOR FURTHER READINGS

Preservation methods for food product to extend shelf life

Total: 45 Hours

Reference(s)

1. Emerging Technologies for Food Processing. Da-Wen Sun (Ed), Academic Press, 1st Edition, 2005
2. Novel Food Processing Technologies. M. P. Cano, M. S. Tapia, and G. V. BarbosaCanovas, CRC Press, 1st Edition, 2004
3. Maria Laura Passos, Claudio P. Ribeiro, Innovation in Food Engineering: New Techniques and Products, CRC press, 2010
4. Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V. M.Balasubramaniam, C. Patrick Dunne, Daniel F. Farkas, James T. C. Yuan, Nonthermal Processing Technologies for Food, 2000

22AG018 FOOD PROCESS EQUIPMENT AND DESIGN

3 0 0 3

Course Objectives

- Impart knowledge on basic principles of designing equipment for food processing Become familiar with design and manufacture of storage tanks, pulpers, heat exchangers, driers etc.
- Provide an idea about devising cold storage units, freezers etc.

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3: 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.
PO4: 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.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO11: 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.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Analyze the process parameters of equipment and design pressure vessels, storage tanks and pulpers
2. Select the suitable products and materials for designing heat exchangers and evaporator
3. Design and analyze the performance of dryers and extruders
4. Estimate the cooling load of cold storage and design a cold storage for fruits and vegetables
5. Analyze and determine the parameter for designing size reduction and conveying equipment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	2	1	-	1	-	-	1	-	-	-	-	1	-
2	3	-	2	-	-	-	-	-	-	-	1	-	-	2	-
3	3	-	2	1	-	-	-	-	-	-	2	-	-	1	-
4	2	-	2	-	-	1	1	-	-	-	2	-	-	2	-
5	2	-	2	-	-	2	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

DESIGN OF PRESSURE VESSELS, STORAGE TANKS AND PULPER

Introduction to design - principles and selection of food processing equipment - design of pressure vessels - design aspects of storage tanks, design of sterilizers and process vats - design of pulper - design considerations - materials of construction - installation and operation.

UNIT II **9 Hours**

DESIGN OF HEAT EXCHANGERS AND EVAPORATORS

Design of heat exchangers - plate heat exchanger, shell and tube heat exchangers - materials of construction - installation and operation - design of single effect evaporators - applications -multiple effect evaporators-entrainment separators-installation and maintenance.

UNIT III **9 Hours**

DESIGN OF DRYERS AND EXTRUDERS

Design of dryers - cabinet dryer, fluidized bed dryer, heat pump dryer, foam mat dryer - freeze dryer - Spray dryer - design considerations, installation, operation and maintenance - design considerations of food extruders - single and twin screw extruders - installation, operation and maintenance of food extruders.

UNIT IV **9 Hours**

DESIGN OF COLD STORAGE AND FREEZERS

Design of cold storage - estimation of cooling load - construction, operation and maintenance of cold storage -design consideration for controlled atmospheric storage and modified atmospheric storage of perishables - design of freezers - types of freezers - design considerations - construction and operation-design of frozen storage.

UNIT V **9 Hours**

DESIGN OF SIZE REDUCTION AND CONVEYING EQUIPMENTS

Design consideration of size reduction equipment- installation and maintenance-design consideration of material conveying equipment- belt conveyor- screw conveyor - bucket elevator- pneumatic conveyor.

Total: 45 Hours

Reference(s)

1. P.S. Phirke, Processing and conveying equipment design, Jain Brothers, New Delhi, 2004
2. M.V. Joshi and V.V. Mahajani, Process Equipment Design (3rd edition), New India Publishing Agency, New Delhi, 2004
3. Jasim Ahmed and Mohammad Shafiur Rahman (Editors), Handbook of Food Process Design, John Wiley and Sons, Ltd., U.K., 2012
4. Kennath. J. Valentas and R.Paul Singh (Editors), Handbook of Food Engineering Practice, CRC Press, London, 1997
5. Zacharias B. Maroulis and George D. Saravacos, Food Process Design, Marcel Dekker, Inc.

22AG019 BIO AND THERMO CHEMICAL CONVERSION OF BIOMASS

3 0 0 3

Course Objectives

- To acquire knowledge on the biomass characteristics and biochemical conversion technologies of biomass for energy generation
- To learn thermochemical conversion technologies for converting biomass into energy
- To understand the cogeneration system and waste heat recovery

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector

Course Outcomes (COs)

1. Assess the basics of biomass characteristics and supply chain management of biomass
2. Analyze the biochemical conversion technologies of biomass for energy generation
3. Select the principles of the combustion process for converting biomass into energy
4. Analyze thermochemical conversion technologies of biomass for energy generation
5. Outline the basics of cogeneration and CDM technologies

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	2	1	3	2	3	-	-	-	-	-	-	-	-	-	2
2	1	2	1	3	1	-	1	-	-	-	-	-	-	-	3
3	3	1	2	2	3	-	1	-	-	-	-	-	-	-	2
4	2	3	1	3	2	-	1	-	-	-	-	-	-	-	3
5	1	2	1	3	2	-	1	-	-	-	-	-	-	-	3

UNIT I **9 Hours**

BIOMASS CHARACTERIZATION

Biomass - types - biomass conversion process - fuel from biomass - Photosynthesis - Terms and units used in biomass production - Biomass characterization - physical - chemical and thermal - energy release - Supply chain Management - harvesting - collection - transportation and processing - Importance - Briquetting - types of equipment - Factors affecting - Pelletizing.

UNIT II **11 Hours**

BIOCHEMICAL CONVERSION

Biochemical degradation - Feedstock for biogas production - Process involved - Factors affecting biogas production - Types of biogas plants - Construction details - Operation and maintenance - Utilization of biogas - Slurry handling - utilization and enrichment - high-rate bio methanation process - landfills - Bioethanol - feedstock - process - utilization - composting - methods machinery - Economics of biofuels

UNIT III **9 Hours**

THERMOCHEMICAL CONVERSION BY COMBUSTION

Thermochemical degradation - stoichiometric air requirement - Combustion process - chemistry of combustion - combustion zones - emissions - Co-firing of biomass - types - Direct - Indirect and Parallel - Wood burning stoves - types - operation - Incinerators - Types - Combustion of wastes and MSW

UNIT IV **9 Hours**

THERMOCHEMICAL CONVERSION BY GASIFICATION AND PYROLYSIS

Biomass gasification - chemistry of gasification - types of gasifiers - Gas cleaning - conditioning - utilization of producer gas - emissions - commercial gasifier - Pyrolysis - product recovery - types - biochar - bio-oil - operation recovery

UNIT V **7 Hours**

COGENERATION AND WASTE HEAT RECOVERY

Cogeneration technology - cycles - topping - bottoming - problems - applications - waste heat recovery - heat pipe - heat wheel - Recuperator - Economizer - Carbon cycle - Carbon sequestration - Types -benefits - CDM Concept - CDM Technologies - Carbon Emission Reduction

Total: 45 Hours

Reference(s)

1. Khoiyangbam. R.S, Kumar. S, Gupta.N, Biogas Technology: Towards Sustainable Development. India, Energy and Resources Institute, 2011.
2. Sergio C. Capareda, Introduction to Biomass Energy Conversions, CRC Press, 2014.
3. C.Higmen and M.Vander Burgt, Gasification, Elsevier Science, USA, 2003
4. Ashok Pandy, Thallada Baskar, M.Stocker and Rajeev Sukumaran (Editors), Recent advances in Thermochemical conversion of Biomass. Elsevier Publications, 2015
5. Robert C Brown, Christian Steven (Editors), Thermochemical Processing of Biomass: Conversion into Fuels, chemical and powder, Wiley Eastern Publishers, 2011
6. K.C. Khandelwal and S.S. Mahdi, Biogas Technology, Tata McGraw Hill Pub. Co. Ltd., New Delhi,1986

22AG020 SOLAR AND WIND ENGINEERING 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Assess the basics of solar energy and solar thermal energy conversion technologies and compare direct mode and indirect mode solar dryers
2. Analyze the principles and applications of solar thermal power stations, solar pond, and solar stills
3. Find the wind power laws and calculate the torque and power characteristics of wind energy
4. Design wind mills and test the units for certification
5. Assess the principles of geothermal energy, wave energy, tidal energy, OTEC energy, fuel cells and analyze their applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	3	2	3	-	1	-	-	-	-	-	-	-	3
2	1	2	1	3	1	-	1	-	-	-	-	-	-	-	3
3	3	1	2	2	3	-	1	-	-	-	-	-	-	-	3
4	2	3	1	3	2	-	1	-	-	-	-	-	-	-	2
5	1	2	1	3	2	-	1	-	-	-	-	-	-	-	3

UNIT I **9 Hours**

SOLAR ENERGY RADIATION AND NON-CONCENTRATING COLLECTORS

Solar constant - Solar Radiation Types - Geometry - measurement - Pyranometer - Pyrheliometer - Greenhouse Effect - Flat Plate Collector - transmittance - absorptance - Energy Balance Equation - collector efficiency - absorber plate - types - selective surfaces - Solar Dyer - Direct - Indirect and Combined Mode - Application.

UNIT II **9 Hours**

SOLAR CONCENTRATING COLLECTORS AND PV TECHNOLOGY

Line-focusing and point-focusing concentrators - parabolic trough - parabolic dish - heliostat field with central receiver - Fresnel lenses - compound parabolic concentrator - Sun tracking mechanisms - Solar Still - Types - Uses - Solar Pond - characteristics - application - Photovoltaics types - Mono - Poly - Thin Film - Mono PERC - Bifacial PERC - characteristic - load estimation batteries inverters operation system controls - Module mounting structure - Tracking system - module cleaning system - PV - powered water pumping system sizing.

UNIT III **9 Hours**

WIND MAPPING ANALYSIS AND CHARACTERISTICS OF WIND

Nature of wind - the origin of wind - Energy in a moving object - Power in the wind - Power absorption by a turbine - Wind speed variation - Velocity and Power duration curve - Wind Resource Assessment - Aerodynamic Force - Lift and Drag Coefficient - Aerofoil - tip speed ratio - torque and power characteristics - Betz coefficient.

UNIT IV **9 Hours**

WIND ENERGY CONVERSION SYSTEM

Wind Turbines Classification - Upwind and Downwind Turbine - Savonius and Darrieus Turbine - Propeller Wind Turbine - Wind Turbine Components - Rotor - Drivetrain - Gearbox - Brake - Generator - Nacelle - Yaw System - Tower - Standalone system - grid system - batteries - Wind energy storage - wind farms - wheeling and banking - testing and certification procedures.

UNIT V **9 Hours**

ALTERNATE ENERGY SOURCES

Ocean energy - offshore and onshore ocean energy conversion technologies - OTEC principles - open and closed cycles - Tidal energy - high and low tides - tidal power - tidal energy conversion -Geothermal energy - resources - classification and types of geothermal power plants - Nuclear energy - reactions - fusion - fission - hybrid reactors - Fuel cell - principle and operation - classification and types - Energy storage - pumped hydro and underground pumped hydro - compressed air - battery - flywheel - thermal.

Total: 45 Hours

Reference(s)

1. Rai.G.D, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 2018.
2. Rao.S., Parulekar.B.B, Energy Technology Non-Conventional, Renewable & Conventional, Khanna Publishers, New Delhi, 2015.
3. Ahmad Hemami, Wind Turbine Technology, Cengage Learning, New Delhi, 2012.

22AG021 ENERGY CONSERVATION IN AGRO BASED INDUSTRY

3 0 0 3

Course Objectives

- To learn about the basic process carried out in various Agro-based Industries
- To learn the different aspects of energy auditing in the Food Industry
- To know about the energy saving opportunities in existing food processing facilities

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Apply energy management principles, techniques, and audits to optimize energy consumption while ensuring energy security
2. Analyze energy conservation opportunities and savings potential in industrial and agricultural sectors across key energy-consuming systems
3. Analyze energy consumption patterns and conservation strategies in various food processing facilities
4. Outline the concepts of anaerobic digestion, fermentation, biodiesel production, and thermochemical conversion of food processing wastes for energy utilization
5. Analyze novel thermodynamic cycles for waste heat recovery and thermal energy storage to enhance energy efficiency in food processing facilities

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
1	3	1	2	1	-	-	-	-	1	-	-	1	-	1	-
2	1	2	1	-	-	-	-	-	-	-	-	-	2	-	-
3	1	2	1	-	-	-	-	-	-	-	-	3	-	-	-
4	1	2	1	-	-	-	-	-	-	-	-	3	-	-	-
5	1	2	1	3	2	-	1	-	-	-	-	-	-	-	-

UNIT I **12 Hours**

ENERGY MANAGEMENT

Defining Energy Management - the need for Energy Management - Energy management techniques - the importance of Energy Management - managing Energy consumption - Energy Audit and Types -and Energy Audit Instruments - understanding Energy costs - benchmarking - Energy performance - matching energy use to requirements optimizing the input - fuel and energy substitution - material and Energy balance diagrams - Energy pricing - Energy and Environment and Energy Security.

UNIT II **10 Hours**

ENERGY CONSERVATION IN AGRO-BASED INDUSTRY

Energy Conservation in the Indian industrial sector - Energy saving potential in the industry - boiler - furnaces - air compressors - refrigeration systems - heat exchangers - heat pumps - turbines - electric drives - pumps - cooling towers - fans - and blowers - Energy Conservation in agriculture sector - Energy Conservation opportunities in pumps used in agriculture sector - summary.

UNIT III **9 Hours**

ENERGY-SAVING OPPORTUNITIES IN EXISTING FOOD PROCESSING

Facilities Energy Consumption pattern - Energy Conservation in Grains and Oilseeds Milling Facilities - Sugar and Confectionary Processing Facilities - Fruit and Vegetable Processing Facilities -Dairy Processing Facilities - Meat Processing Facilities - Bakery Processing Facilities.

UNIT IV **8 Hours**

FOOD PROCESSING WASTES AND UTILIZATION

Concepts of Anaerobic Digestion of Food Processing Wastes - Fermentation of Food Processing Wastes into Transportation Alcohols - Bio-diesel Production from Waste Oils and Fats -Thermochemical Conversion of Food Processing Wastes for Energy Utilization.

UNIT V **6 Hours**

WASTE HEAT RECOVERY

Waste Heat Recovery and Thermal Energy Storage in Food Processing Facilities - Novel Thermodynamic Cycles Applied to the Food Industry for Improved Energy Efficiency

Total: 45 Hours

Reference(s)

1. Umesh Rathore," energy management", Kataria publications, 2 nd ediiton,2014.
2. G Harihara Iyer, Green Building Fundamentals, Notion press.com, 2022

3. Guidebooks for National Certification Examination for Energy Manager/Energy Auditors Book-1, General Aspects
4. Umesh Rathore, "energy management", Kataria publications, 2nd ediiton, 2014
5. L.Wang, Energy Efficiency and Management in Food Processing Facilities, CRC Press, 2009

22AG022 COGENERATION AND WASTE HEAT RECOVERY SYSTEMS

3 0 0 3

Course Objectives

- To acquire knowledge on the various seed production and processing technologies
- To impart knowledge on seed testing and the methods
- To impart knowledge about seed certification, legislation, and industries in India

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Assess the principles of cogeneration and analyze thermodynamic power cycles
2. Evaluate the performance of cogeneration systems
3. Assess the cogeneration technologies based on steam turbines, gas turbines and IC engines
4. Organise the issues and applications of cogeneration technologies
5. Analyze the waste heat recovery systems, economic analysis, and environmental consideration

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	2	1	3	2	3	2	-	-	-	-	-	-	-	-	-
2	2	3	2	1	3	1	-	-	-	-	-	-	-	-	-
3	1	2	3	3	1	3	-	-	-	-	-	-	-	-	-
4	3	3	1	3	3	1	-	-	-	-	-	-	-	-	-
5	1	3	2	2	2	1	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

INTRODUCTION

Cogeneration principles and definition - thermodynamics power cycle analysis - Rankine and Brayton cycles- topping and bottoming cycles

UNIT II **9 Hours**

COGENERATION SYSTEMS

Performance indices of cogeneration systems - Cogeneration systems based on steam turbine - gas turbine - combined cycle and IC engines - Cogeneration systems based on Stirling Engines

UNIT III **9 Hours**

APPLICATIONS OF COGENERATION

Cogeneration Applications in various industries like Cement - Sugar Mill - Paper Mill - Textile - Sizing of waste heat boilers - Performance calculations - Part load characteristics selection of Cogeneration Technologies - Financial considerations - Operating and Investments - Costs of Cogeneration - Impacts of cogeneration plants- fuel- electricity

UNIT IV **9 Hours**

WASTE HEAT SOURCES

Selection criteria for waste heat recovery technologies - Recuperators - Regenerators - Economizers - Plate Heat Exchangers - Waste Heat Boilers-Classification - Location - Service Conditions - Design Considerations - Unfired combined Cycle - supplementary fired combined cycle - fired combined cycle applications in Industries - fluidized bed heat exchangers - heat pipe exchangers - Heat pumps - types-design

UNIT V **9 Hours**

COST ANALYSIS AND ENVIRONMENTAL IMPACT OF COGENERATION SYSTEMS

Economic analysis of cogeneration and waste heat recovery systems - Regulatory and financial framework for cogeneration and waste heat recovery systems - Environmental considerations - mitigation of harmful emissions from energy production - conversion and utilization technologies- control of air - water and ground pollution

Total: 45 Hours

Reference(s)

1. J.F Harrington and J.E Douglas, "Seed storage and packaging application", NSC, New Delhi, 1963
2. J.E Douglas, "Seed Production Mannual", National Seeds Corporation and Rockfeller Foundation, New Delhi, 1969
3. J.E Douglas, "Seed Certification Mannual", National seeds corporation, New Delhi, 1970
4. R.L Agrawal, A text book on "Seed Technology", Oxford & IBH Publication, Co Pvt Ltd, New Delhi-1992
5. L.O Copeland and M.B Mc Donald, "Principles of Seed Science and Technology", Chapman and Hall, New York, 1995

22AG023 GREEN BUILDINGS 3 0 0 3

Course Objectives

- To imbibe the basics of green buildings and to learn guidelines for the development and certification of green designs.
- To identify various areas of implementing strategies for green design in projects to enhance the built environment.
- To impart knowledge on site selection, waste management, water, and energy efficiency, and indoor environmental quality of green buildings

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Execute the concept of green buildings and its certification
2. Assess the site selection criteria and water management in green buildings
3. Analyze energy efficiency strategies in building construction to optimize sustainability and achieve net zero energy performance
4. Assess appropriate green building material and analyse waste management strategies
5. Analyze the impact of indoor environmental quality factors on occupant comfort and well-being

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	3	2	3	2	-	-	-	-	-	-	-	-	1
2	2	3	2	1	3	1	-	-	-	-	-	-	-	-	2
3	1	2	3	3	1	3	-	1	-	-	-	-	-	-	2
4	3	3	1	3	3	1	-	1	-	-	-	-	-	-	1
5	1	3	2	2	2	1	-	1	-	-	-	-	-	-	1

UNIT I **9 Hours**

CONCEPT OF GREEN BUILDINGS AND ITS CERTIFICATION

Introduction to Green Buildings - Definition of green buildings and sustainable development - typical features of green buildings - benefits of green buildings towards sustainable development - green building rating systems - GRIHA - IGBC and LEED - overview of the criteria as per these rating systems.

UNIT II **9 Hours**

SITE SELECTION AND WATER CONSERVATION AND EFFICIENCY

Site selection and planning - Criteria for site selection - preservation of landscape - soil erosion control - minimizing urban heat island effect - maximizing comfort by proper orientation of building facades - daylighting - ventilation - Water conservation and efficiency - Rainwater harvesting methods for roof and non-roof - reducing landscape water demand by proper irrigation systems -water-efficient plumbing systems - water metering - wastewater treatment - recycle and reuse systems

UNIT III **9 Hours**

ENERGY EFFICIENCY AND USE OF RENEWABLE ENERGY IN GREEN BUILDINGS

Energy Efficiency - Environmental impact of building constructions - Concepts of embodied energy - operational energy and life cycle energy - Methods to reduce operational energy - Energy-efficient building envelopes - efficient lighting technologies - energy-efficient appliances for heating and air conditioning systems in buildings - zero ozone-depleting potential (ODP) materials - wind and solar energy harvesting - energy metering, and monitoring - the concept of net zero buildings.

UNIT IV **9 Hours**

WASTE MANAGEMENT AND BUILDING MATERIALS USED IN GREEN BUILDINGS

Building materials - Methods to reduce embodied energy in building materials - Use of local building materials - Use of natural and renewable materials like bamboo - timber - rammed earth and stabilized mud blocks - use of materials with recycled content such as blended cement - pozzolana cement - fly ash bricks - vitrified tiles - materials from agro and industrial waste - reuse of waste and salvaged materials Waste Management - Handling of construction waste materials - separation of household waste - on-site and off-site organic waste management.

UNIT V **9 Hours**

INDOOR ENVIRONMENTAL QUALITY

Indoor Environmental Quality for Occupant Comfort and Wellbeing - Daylighting - air ventilation - exhaust systems - low VOC paints - materials and adhesives and building acoustics - Heating and cooling - Codes related to green buildings - NBC - ECBC - ASHRAE - UPC.

Total: 45 Hours

Reference(s)

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
3. Alternative building materials and technologies by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. Mike Montoya, Green Building Fundamentals, Pearson, USA, 2010
5. Charles J. Kibert, Sustainable Construction, Green Building Design and Delivery, John Wiley & Sons, New York, 2008.
6. 8Regina Leffers, Sustainable Construction and Design, Pearson, Prentice Hall, USA, 2009

22AG024 ENERGY STORAGE SYSTEMS 3 0 0 3

Course Objectives

- To understand the necessity of different energy storage systems
- To study details of various energy storage systems along with applications
- Enabling to identify the optimal solutions to a particular energy storage application/utility

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Analyze the scope, needs, opportunities, and technological advancements in energy storage systems
2. Find knowledge pertaining to various ways of thermal energy storage, its analysis and use
3. Analyze the principles, applications, advantages, limitations, challenges, and future prospects of chemical energy storage systems
4. Assess knowledge pertaining to various ways of electromagnetic and mechanical energy storage, its analysis and use
5. Analyze the working principles, performance evaluation methods, and key characteristics of batteries and supercapacitors

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	3	1	2	1	-	-	-	-	1	-	-	1	-	1	-
2	1	2	1	-	-	-	-	-	-	-	-	-	2	-	-
3	1	2	1	-	-	-	-	-	-	-	-	3	-	-	-
4	1	2	1	-	-	-	-	-	-	-	-	3	-	-	-
5	1	2	2	2	2	1	-	-	1	-	-	3	-	-	-

UNIT I **9 Hours**

OVERVIEW OF ENERGY STORAGE SYSTEMS

Energy storage systems overview - Scope of energy storage - needs and opportunities in energy storage - Technology overview and key disciplines - comparison of the time scale of storages and applications - Energy storage in the power and transportation sectors - Importance of energy storage systems in electric vehicles - Current electric vehicle market.

UNIT II **9 Hours**

THERMAL ENERGY STORAGE SYSTEMS

Thermal storage system - heat pumps - hot water storage tank -solar thermal collector - application of phase change materials for heat storage-organic and inorganic materials - efficiencies and economic - evaluation of thermal energy storage systems

UNIT III **9 Hours**

CHEMICAL ENERGY STORAGE SYSTEMS

Chemical storage system - hydrogen - methane - concept of chemical storage - application of chemical energy storage system - advantages and limitations of chemical energy storage - challenges and future prospects of chemical storage systems.

UNIT IV **9 Hours**

ELECTROMAGNETIC AND MECHANICAL ENERGY STORAGE SYSTEMS

Electromagnetic storage systems - double-layer capacitors with electrostatically charge storage - superconducting magnetic energy storage (SMES) - concepts - advantages and limitations of electromagnetic energy storage systems - Mechanical-Pumped hydro - flywheels and pressurized air energy storage

UNIT V **9 Hours**

ELECTROCHEMICAL STORAGE SYSTEMS

Indoor Environmental Batteries - Working principle of battery - primary and secondary (flow) batteries - battery performance evaluation methods - major battery chemistries and their voltages- Li-ion battery & Metal hydride battery vs lead-acid battery - Supercapacitors - Working principle of the supercapacitor - types of supercapacitors- cycling and performance characteristics - the difference between battery and supercapacitors - Introduction to Hybrid electrochemical supercapacitors

Total: 45 Hours

Reference(s)

1. Energy Storage,Technologies and Applications by Ahmed Faheem Zobaa, InTech.
2. Fundamentals of Energy Storage by J. Jensen and B. Sorenson, Wiley-Interscience, New York
3. Handbook of battery materials by C. Daniel, J. O. Besenhard,Wiley VCH Verlag GmbH & Co. KgaA
4. Electric & Hybrid Vehicles by G. Pistoia, Elsevier B. V.
5. Thermal energy storage: Systems and Applications by Dincer I. and Rosen M. A., Wiley pub.
6. Energy Storage: Fundmentals, Materials and Applications, by Huggins R. A., Springer

22AG025 CDM AND CARBON TRADING TECHNOLOGY

3 0 0 3

Course Objectives

- To know the basics and importance of clean development mechanism (CDM)
- To monitor CDM for sustainable development and know about carbon credit
- To know the concept of carbon trading

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Execute the effects of greenhouse gas emission and explain the responsibilities of countries in GHG emission
2. Assess the Kyoto Protocol and develop clean development mechanism (CDM) projects
3. Execute the features of CDM and employ monitoring and auditing techniques on CDM projects
4. Develop guidelines for small-scale and Land Use, Land Use Change, and Forestry (LULUCF) CDM projects
5. Compare the alternate techniques for lowering carbon emission

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	3	1	2	1	-	-	-	-	1	-	-	1	-	1	-
2	1	2	1	-	-	-	-	-	-	-	-	-	2	-	-
3	1	2	1	-	-	-	-	-	-	-	-	3	-	-	-

4	1	2	1	-	-	-	-	-	-	-	-	3	-	-	-
5	1	2	2	2	2	1	-	-	1	-	-	3	-	-	-

UNIT I **9 Hours**

GREEN HOUSE GASES AND ENVIRONMENTAL CHANGE

Global Environmental Changes - United nations framework convention on climate change-United (UNFCC)-ozone layer depletion -land degradation-air and water pollution-sea-level rise-loss of biodiversity-climatic change problem GHG emissions by different countries-developing country responsibilities - India"s Greenhouse gas emissions - Conference of parties

UNIT II **9 Hours**

KYOTO PROTOCOL AND CDM PROJECTS

Kyoto protocol and clean development mechanism-CDM and cooperative mechanism-CDM overview administration -participation-CDM institutions-procedures CDM project cycle-project design and formulation - eligibility-additionally. Approval of (DNA) Designated National Authority - Validation and registration-monitoring-validation and certification through the source of Certified Emission Reduction (CER)

UNIT III **9 Hours**

TYPES AND FEATURES OF CDM

Types of CDM topologies -project activity -small-scale CDM project categories- access station and cater station projects - PDO- project design document -General description of project activity-baseline methodology-monitoring methodology-auditing period-technical aspects

UNIT IV **9 Hours**

MONITORING OF CDM

Monitoring and verification-verification process principles of verification-report preparation-pitfalls - Joint implementation (JI)-institutions and procedures-guidelines-JI or small-scale projects-JI Land Use - Land Use Change and Forestry (LULUCF) projects

UNIT V **9 Hours**

SUSTAINABLE ENERGY DEVELOPMENT

Low carbon technologies-low carbon building-alternative approaches-energy efficiency projects-sustainable energy policy concepts-mitigating energy-related GHG emissions through renewable energy-carbon trading

Total: 45 Hours

Reference(s)

1. CDM Manual for project developers and policy makers-UNFCCC Publication, 2007
2. Myungkyoon Lee, Information and Guide Book - the UNEP project CD4CDM-UNEP publication, June 2004.
3. MyungKyoon Lee, Baseline Methodologies for clean Development Mechanism Projects- A Guide Book-Vol.1, UNEP publication, 2005
4. Aukland L, Bass S, Hug S, Landell Mals N, Tipper R, Laying the Foundations for clean Development, Preparing the Land use sector London, 2002
5. Carbon sequestration in dryland soils, World Soil Resources report No.102, Food and Agriculture Organization, Rome,2004

22AG026 SOIL FERTILITY AND NUTRIENT MANAGEMENT

3 0 0 3

Course Objectives

- To enhance the knowledge on soil fertility and soil formation processes.
- To impart knowledge on essential nutrients and its movements in soil-plant.
- To study the transformation of nutrients and its formation and functions.
- To study the manures and fertilizers application for the improvement of soil fertility.
- To analyze the soil and plant samples for better crop production.

Programme Outcomes (POs)

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Assess the classification of soil and land capability, soil erosion and its control
2. Execute the functions and nutrients supply from soil to plant
3. Compare the nutrient transformation in relation to soil-plant systems
4. Outline the manure and fertilizers for crop production
5. Determine the soil fertility by conducting the soil tests using different methods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	1	-	-	-	-	2	-	1	-	-	3	1	-	-
2	-	3	1	-	1	-	-	-	1	-	-	2	2	-	1
3	-	-	1	-	-	-	-	-	-	-	-	1	1	-	2

4	-	1	3	-	-	-	-	-	-	-	-	-	2	-	1
5	-	1	3	-	-	-	-	-	-	-	-	-	2	-	3

UNIT I **10 Hours**

SOIL AS A NATURAL RESOURCE

Definition of Soil-Soil Fertility and Soil Productivity-soil formation process-soil & land capability classification-soil acidity and alkalinity-soil erosion and its control-soil organisms-organic matter-modern views of humus formation-lant Growth & Response Curves-liebig law of minimum-Mitscherlich law.

UNIT II **9 Hours**

BASIC SOIL-PLANT RELATIONSHIPS

Essential plant nutrients-Definition of macro and micro nutrients-Functions and deficiency symptoms-Hidden hunger-Beneficial elements-Criteria of essentiality of elements-Luxury consumption of nutrients-SUPPLY OF NUTRIENTS FROM organic matter-movement of ions from soils to roots -Mass flow-diffusion-root interception-nutrient mobility in soil-ion absorption by plants.

UNIT III **10 Hours**

NUTRIENT TRANSFORMATION IN RELATION TO SOIL-PLANT SYSTEMS

The functions and forms of N, P, K in soil-Biological N2 fixation-losses of nitrogen from soils-leaching-denitification-forms of P in soil-P sources-Factors affecting K availability-sulfur, calcium and magnesium-cycle-forms and functions in plants.

UNIT IV **8 Hours**

MANURES AND FERTILIZERS

Definition-characteristics of manure-classification-sustainable agriculture-composts-methods of composting-organic farming-LEISA-fertilizer-classification-recommendations in agriculture crops-Calculation and application of fertilizers in soil-Nano fertilizer-soil testing and its importance.

UNIT V **8 Hours**

SOIL FERTILITY EVALUATION AND MAINTENANCE OF SOIL HEALTH

Characteristics of a healthy soil-Measure of soil health-soil health indicators-soil health report-problem soils-Plant analysis-total analysis, rapid tissue test, enzyme test, DRIS method and critical levels of nutrients in plants-problem due to excessive use of chemical fertilizers-crop residue management.

Total: 45 Hours

Reference(s)

1. John L.Halvin, Samuel.L.Tisdale, Werner.L.Nelson, James.D.Beaton, Soil fertility and fertilizers, an introduction to nutrient management, Eighth edition, PEARSON India education services, 2017.
2. Dilip Kumar Das, Introductory Soil Science, 3rd Edition, Kalyani Publishers, Ludhiana, 2013.
3. T.D. Biswas and S.K. Mukherjee, Text Book of Soil Science, 2nd Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2001.
4. Mukund Joshi and Prabhakarasetty, T.K. 2006. Sustainability through organic farming. Indian Society of Soil Science, Fundamentals of Soil Science, ISSS Publication, IARI, New Delhi, 2012.Kalyani publishers, New Delhi. 349p
5. E-Course Indian council of Agricultural Research.

22AG027 PLANT PROTECTION 3 0 0 3

Course Objectives

- To impart basic knowledge of insect pest and diseases and their losses caused to crops
- To study various methods of plant protection to get more yield in Agricultural and Horticultural crops
- To gain knowledge on pest & diseases management in horticultural crops

Programme Outcomes (POs)

PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: 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.
PO11: 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.
PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Assess the various groups of insect pests and diseases of crops and their symptoms of damage
2. Assess the different crops damaged by insects and diseases
3. Compare the various methods of pest management to increase crop yield
4. Outline the various plant protection machineries
5. Determine the integrated pest and disease management in organic and inorganic farming

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	-	-	1	3	-	-	-	-	-	-	-	3	1	-	-
2	-	-	2	1	1	-	2	1	-	-	2	3	1	-	
3	-	-	2	2	2	-	2	1	2	-	-	3	1	-	1
4	-	-	2	2	2	-	2	-	2	1	-	3	2	-	1
5	-	-	-	2	1	-	2	2	2	-	-	2	2	-	2

UNIT I **9 Hours**

GROUPS OF INSECTS AND DISEASE

Sucking pests, borer pests, soil pests, Vectors, Rodent pests and their symptoms of damage- Fungal bacterial and viral pathogens causing crop diseases

UNIT II **9 Hours**

AGRICULTURE AND HORTICULTURE CROP PESTS

Insect pests of agricultrual crops - rice, pulses, cotton, sugarcane - Horticultural crops - coconut, fruits, vegetables, and flower crops affected by various pests and disease - Storage insects - distribution, host range, bio-ecology, injury, integrated management of important insect pest

UNIT III **9 Hours**

METHODS OF CROP PROTECTION

Cultural, physical, mechanical, legal, biological, chemical and biotechnological methods of crop protection, IPM, Organic farming - Organic production requirements; Biological intensive nutrient management- organic manures, vermicomposting, green manuring

UNIT IV **9 Hours**

PLANT PROTECTION APPLIANCES

Different machineries available for spraying and soil application on annual and perennial crops and maintenance of machineries

UNIT V **9 Hours**

PESTICIDE HAZARDS AND MANAGEMENT

Pesticide residues in consumable crop parts by way of application of pesticides and fungicides, methods of decontamination of toxic chemicals, organic healthy way of crop protection

FOR FURTHER READING

Mode of spread of pest and diseases, prophylactic measures to manage pests mode of action of pesticides, complex problems in plant protection

Total: 45 Hours

Reference(s)

1. Dhandapani, N and S.Uthamasamy 2000. Integrated pest Management. Tnau Publications, Coimbatore.p.181

2. Ragupathy. A and R. Ayyasamy 2003. A Guide on crop pests. Namrutha publications, Madananadapuram, Porur, Chennai 16.p.368
3. Justin. K.2004. Crop protection. TNAU, Petchipaarai, kanyakumari Dt.p.379
4. David, B.V. and T. kumaraswami 1975. Elements of Economic Entomology. Popular Book Depot, Chennai-600034.p.507. 16. 2003

22AG028 EXTENSION METHODOLOGY AND TRANSFER OF TECHNOLOGY

3 0 0 3

Course Objectives

- To familiarize with proper communication techniques
- To expose the students to different extension teaching methods
- Utilizing all the electronic media for transfer of technology

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: 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.
PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Assess the way to Communicate in proper channel
2. Organize the various extension teaching methods and communication gadgets
3. Integrate the use of electronic media for transfer of technology
4. Attribute the way of Strengthen to build experiential learning
5. Support to participate in all extension activities

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	1	1	1	-	1	2	-	2	3	-	1	1	-	-
2	-	-	-	1	-	-	2	-	3	2	-	1	1	-	-
3	1	-	-	1	3	2	-	-	3	-	-	2	1	-	1
4	-	-	-	1	2	1	-	2		3	-	1	1	-	-
5	-	-	-	1	2	-	-	-	2	3	-	2	-	-	1

UNIT I **9 Hours**

COMMUNICATION

Communication meaning, definition, types; Communication models - Aristotle, Shanon-Weaver, Berlo, Schramm, Leagans, Rogers & Shoemaker elements and their characteristics; Barriers in communication - Transfer of technology - meaning and concepts - Systems of transfer of technology - Knowledge Generating System - Knowledge Disseminating System - Knowledge Consuming System

UNIT II **9 Hours**

EXTENSION TEACHING METHODS

Extension teaching methods, meaning, definition, functions, classification - individual, group, mass contact methods- merits and demerits; Audio aids, Visual aids and Audio-Visual aids, definition, classification, purpose, planning, selection, combination, use; Training, definition, types, training functions of FTC, KVK, EEI, MANAGE, NAARM

UNIT III **9 Hours**

E-EXTENSION

e-Extension, Community Radio, Internet, cyber cafes, video and teleconferencing, Interactive Multimedia Compact disk, Agri portals, Information Kiosks, Kisan Call Centre, Mobile phone, Expert System, Village Knowledge Centre, DEMIC, consultancy clinics, Geographical Information System; Agricultural journalism, definition, principles, importance, ABC of news, types of news

UNIT IV **9 Hours**

EXPERIENTIAL LEARNING, SYSTEMS THINKING

Experiential Learning, concept, three types of learning: Scientia, Techne & Praxis; Kolbs Cycle; Systems Thinking: concept, importance, Hard System vs Soft System, Four World Views; Modelling the Farm System: production system, human activity system, marketing system, natural resource system, management system, Supra systems

UNIT V **9 Hours**

PARTICIPATORY EXTENSION, DIFFUSION OF INNOVATIONS

Participatory Extension Approaches: RRA, PRA; Diffusion of Innovations: definition, elements; Innovation: definition, attributes; Adoption: meaning, steps in adoption process, adopter categories, factors influencing adoption of innovations; Consequences of innovations

FOR FURTHER READING
The Challenger case study: Bhopal Gas Tragedy: The Three Mile Island and Chernobyl case studies: Fundamental Rights, Responsibilities and Duties of Indian Citizens: Sample code of ethics like IETE, ASME, ASCE, IEEE, Institution of Engineers India, Indian Institute of Materials Management

Total: 45 Hours

Reference(s)

1. Berlo, D.K. 1960. The Process of Communication. Holt, Rinehart and Winston, New York
2. Dass, R. 1981. Appropriate Technology - Percepts and Practices Vintage Press Inc., New York
3. Ray, G.L. 1991. Extension Communication and Management. Kalyani Publishers, Kolkata
4. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2014
5. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012
6. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi, 2006

22AG029 AGRICULTURAL MARKETING 3 0 0 3

Course Objectives

- To expose the students to know about marketing the Agricultural products from the point of production to the point of consumption / utilization
- To import knowledge on marketing strategies and functions
- To possess the knowledge on export and import market functioning system

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO11: 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.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging

Course Outcomes (COs)

1. Assess the market conduct and functions
2. Compare with various market channels and prices
3. Analyze the marketing institutions with various parameter
4. Outline the Agricultural products trading
5. Determine the product prices and risk management

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	1	1	3	2	1	2	2	1	2	2	1	1	-	-
2	-	1	1	3	2	1	-	1	2	3	2	1	-	2	-
3	-	1	2	2	3	1	-	2	2	2	-	2	-	1	-
4	-	1	2	3	2	-	-	1	2	2	2	1	-	2	-
5	-	1	1	2	3	1	-	1	2	2	2	1	-	1	-

UNIT I **9 Hours**

MARKET STRUCTURE CONDUCT AND PERFORMANCE

Components: Dynamics of Market Structure, Agricultural Marketing and Economic Development, Marketing Functions and their Classification, Marketing Agencies: Producers, Middlemen, Retailers, Commission Agents, Brokers, Advertising Agency: Marketing Institutions

UNIT II **9 Hours**

MARKETING CHANNELS, MARKETING COST, MARKETING EFFICIENCY AND MARKET INTEGRATION

Marketing Channels: Factors affecting Marketing Channels; Marketing Channels for various products, Innovative Marketing Channels, Market Integration: Types, Marketing Cost in India, Reducing Marketing Cost, Relationship of Farmers Price and Consumers Price

UNIT III **9 Hours**

COOPERATIVE AGRICULTURAL MARKETING INSTITUTIONS

Functions: Types, Single Commodity Multi Commodity, Multi purpose, Multi commodity Structure; Membership: Sources of Finance, Functioning, Cooperative Processing, NAFED, NCDC, NDDB, TANFE

UNIT IV **9 Hours**

EXTERNAL TRADE IN AGRICULTURAL PRODUCTS

Trade Policy for Agriculture: Share of Agricultural Products in Total Imports and Exports of India, Changes in India"s Agricultural Export Basket, Recent Policies on Trade, GATT: The General Agreement on Trade and Tariffs, World Trade Organization

UNIT V **9 Hours**

AGRICULTURAL PRICES AND RISK MANAGEMENT

Commission for Agricultural Costs and Prices: Price Policy, risks-minimization of risk, Future Trading, Dangers of Forward Market, Contract Farming and Contract Marketing

FOR FURTHER READING

Case studies on regulated markets for agricultural commodities

Total: 45 Hours

Reference(s)

1. Acharya S.S and N.L. Agarwal. 2012. Agricultural marketing in India. Oxford and Ibh publishing co.pvt.Ltd., New Delhi

2. Agricultural Marketing in Tamil Nadu, Department of Agricultural Marketing,Government of Tamil Nadu, Chennai, 2000
3. Khols, R.L. and Damey, Marketing of Agricultural Products, McMillan Company, New York, 1972
4. Wader, L.K. 2013.Text Book Of Agricultural Marketing And Cooperation. ICAR New Delhi

22AG030 INTEGRATED FARMING SYSTEM 3 0 0 3

Course Objectives

- To study about the basic principles of farming system aspects.
- To learn the sustainable farming practices of varies IFS models to increase the food production.
- To impart basic knowledge of different IFS units in farming system.
- To study various resource management strategies in farming systems.
- To learn about different resource recycling for effective crop production.

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Execute the concepts and principles of farming systems and IFS models to increase the crop productivity.
2. Assess the various sustainable farming practices for raising different farming methods.
3. Design the different IFS components in farming system.
4. Analyze the resource management strategies in farming for effective utilization.
5. Determine the various resource recycling and residue management methodologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	-	-	-	-	1	-	-	-	-	-	1	-	-
2	-	2	1	-	1	-	1	-	1	-	-	-	1	-	-

3	-	-	1	-	-	-	-	-	-	-	-	1	-	-	2
4	-	1	3	-	-	-	-	-	-	-	-	-	-	1	-
5	-	1	3	-	-	-	-	-	-	-	-	-	1	-	-

UNIT I **9 Hours**
FARMING SYSTEMS
Farming systems - Principles - scope of Integrated Farming system - evaluation indicators of integrated farming system- Integrated farming system models for different agro eco-systems - LEISA concepts and principles. Cropping systems for different agro climatic zones of India and Tamil Nadu - Crop diversification and intensification in farming system.

UNIT II **9 Hours**
SUSTAINABLE FARMING PRACTICES
Design of heat exchangers - plate heat exchanger, shell and tube heat exchangers - materials of construction - installation and operation - design of single effect evaporators - applications -multiple effect evaporators-entrainment separators-installation and maintenance

UNIT III **9 Hours**
COMPONENTS OF IFS
Integrated Farming system - various components of IFS. Study of different units: dairy, goat, poultry, fishery, mushroom, sericulture and biogas as allied sectors. Carbon foot-printing and greenhouse gas emission - Simulation models for intercropping.

UNIT IV **9 Hours**
RESOURCE MANAGEMENT
Resource use efficiency and optimization techniques - Resource management under IFS - Improving resource use efficiency in agriculture - Cost reduction strategies in crop production - cropping system, farming system and dry farming - Non-monetary inputs and low cost technologies - Labour management

UNIT V **9 Hours**
RESOURCE RECYCLING
Resource recycling - Residue management - crop and livestock - Conservation agriculture - principles, concept and scope- Sustainable Agriculture - flow of energy in different farming systems

Total: 45 Hours

References

1. Devasenapathy, P., T. Ramesh and B. Gangwar 2007.Efficiency indices for agriculture management research. New India Publishing agency, Delhi.
2. Jayanthi, C. Devasenapathy, P and C. Vennila. 2007. Farming Systems. Principles and practices. Satish Serial Publishing House.Delhi.
3. Jayanthi, C., N. Sakthivel, N. Sankaran and T.M. Thiyagarajan. 2003. Integrated Farming system – A Path to Sustainable Agriculture. TNAU Publication.
4. Palaniappan, SP and K. Sivaraman.1996. Cropping systems in the tropics - Principles and management. New Age International (P) Ltd., New Delhi.
5. S.C. Panda. 2003. Cropping and Farming Systems. Agrobios Publishers. Jodhpur

22AG031 SUSTAINABLE AGRICULTURE AND FOOD SECURITY **3 0 0 3**

Course Objectives

- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability
- Importance of science, food security and ecological balance

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Execute the need for sustainable agriculture and land utilization
2. Assess the need for irrigation potential and water resource sustainability
3. Demonstrate organic farming and different sustainable agricultural practices
4. Analyze the ecological balance in food production and nutritional food security
5. Determine the policies and programmes for sustainable agriculture and food security

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	2	2	-	-	-	1	-	-	-	-	-	-	-	1	-
2	2	2	3	-	-	1	-	-	-	-	-	-	-	1	-
3	2	2	3	1		1	-	-	-	-	-	-	-	2	-
4	2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
5	2	-	-	-	-	-	2	3	-	-	-	-	-	2	-

UNIT I **9 Hours**

LAND RESOURCE AND ITS SUSTAINABILITY

Sustainable agriculture- definition, concept, goals; factors affecting ecological balance- land degradation, water and air pollution, global warming, impact and amelioration Sustainable agriculture- problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture. Land Resources of India - Population and land, Land utilization, Net Area Sown, changes in cropping pattern, land degradation

UNIT II **9 Hours**

WATER RESOURCE AND ITS SUSTAINABILITY

Rainfall forecasting - adequacy of rainfall for crop growth - rainfall, drought and production instability - irrigation potential - available, created and utilized - river basins; watersheds and utilizable surface water - utilizable water in future - ground water and surface water

UNIT III **9 Hours**

SUSTAINABLE AGRICULTURE

Agro ecosystem - impact of climate change on agriculture, effect on crop yield, effect on soil fertility - food grain production at state level - indicators on sustainable food availability - indicators of food production sustenance - natural farming principles - sustainability in rainfed farming - organic farming: principles and practice - sustainable agriculture practice: natural farming, alternative farming, integrated farming

UNIT IV **9 Hours**

FOOD PRODUCTION AND FOOD SECURITY

Performance of major food crops over the past decade - trends in food production - decline in total factor productivity growth - demand and supply projections - impact of market force - rural land market - emerging water market - vertical farming; food security - concepts and definitions, agriculture and food security, nutrition and health urbanization and food security, food system and food security; sustainable food security indicators and index - indicator of sustainability of food security - path to sustainable development

UNIT V **9 Hours**

POLICES AND PROGRAMMES FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY

HEIA, LEIA and LEISA and its technique for sustainability, integrated farming system - historical background, objectives and characteristics, components of IFS and its advantages; Food and crop production policies - agriculture credit policy - crop insurance - policies of natural resource use - policies for sustainable livelihoods - vritual water and trade - sustainable food security action plan - macroeconomic policies employement and cash income, markets and food prices

FOR FURTHER READING

Precision Agriculture, Integrated Farming System, Bio-farms, Global Positioning System, Geographic Information System, Site Specific Nutrient Management for nutrient and irrigation management practices

Total: 45 Hours

Reference(s)

1. B. K. Desai and Pujari, B.T. Sustainable Agriculture: A vision for future, New India Publishing Agency, New Delhi, 2007
2. Saroja Raman, Agricultural Sustainability: Principles, Processes and Prospects, CRC Press, 2013
3. Sithamparanathan, J., Rengasamy, A., Arunachalam, N. Ecosystem principles and sustainable agriculture, Scitech Publications, Chennai, 1999

4. Gangadhar Banerjee and Srijeet Banerji, Economics of sustainable agriculture and alternate production systems, Ane Books Pvt Ltd., 2017
5. M. S. Swaminathan, Science and sustainable food security, World Scientific Publishing Co., Singapore, 2010
6. Mohan, S., Nair, P.K.R., Long, A.J. 2007. An Assessment of Ecological Diversity in Homegardens: A Case Study from Kerala State, India. Journal of Sustainable Agriculture. Volume 29, Issue 4: 135-153

22AG032 INSTRUMENTATION AND CONTROL ENGINEERING IN AGRICULTURE

3 0 0 3

Course Objectives

- To expose students with electrical and electronic components used in the analytical instruments
- To learn and understand the principles and operation of different instrumentation techniques
- To understand the basic concepts of open loop and closed loop control systems
- To understand the concept of frequency domain analysis
- To understand the concept of stability of a system

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Generalize the function of electrical and optical component in analytical instruments and their calibration
2. Execute the spectroscopic techniques to identify, estimate and characterize analytes
3. Assess the thermal behaviour of materials using thermal analysis
4. Integrate a mathematical model of a physical system and compute the transfer function using Block diagram reduction technique and Signal flow graph
5. Assess the performance of first and second order system and compute the steady state error for different test signals

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	2	2	2	2	1	1	1	-	-	-	-	-	1	1	-
2	2	2	2	1	2	1	1	-	-	-	-	-	1	-	-
3	1	3	3	1	1	1	2	-	-	-	-	-	-	1	-
4	2	2	2	1	1	1	2	-	-	-	-	-	2	-	-
5	2	3	3	1	2	1	1	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

INTRODUCTION

Basic concepts of measurement system configuration. Concept of accuracy, precision error, resolution repeatability bias, calibration, range; Performance characteristics of Instruments- Zero, first and second order instrument systems and their response to different input signals (step, ramp etc) Specification and testing of dynamic response

UNIT II **9 Hours**

INSTRUMENT FOR VARIOUS USES

Different types of measuring instruments, their working principles, construction features, measurement of level, flow, temperature, pressure, vacuum, force, torque, power, displacement, vibration, acceleration, pH, colour, viscosity, surface tension and composition. Indicating and recording type instruments, digital displays, transmitting and telemetering devices

UNIT III **9 Hours**

INTRODUCTION TO CONTROL SYSTEM

Control system characteristics, purpose disturbances and stability Feed back and feed forward control strategies. Modelling the Dynamic and Static Behaviour of Process-Mathematical modelling for physical process control, state variables and state equations, modelling difficulties and considerations. Input-output models block diagram, degree of freedom, process controllers action, P, PI, PID controllers, final control system

UNIT IV **9 Hours**

ANALYSIS OF DYNAMIC BEHAVIOUR

Linearization of systems, Deviation variables, Application of Laplace transform in mathematical modelling of process control. Transfer function; Transfer function matrix. for processes having multiple outputs, Poles and zeros of transfer function

UNIT V **9 Hours**

QUALITATIVE ANALYSIS OF RESPONSE OF SYSTEM

Design of Feed Back System Block diagram, stability analysis, frequency response root locus analysis, Routh"s criteria, Nyquist plots and Bode diagrams. Control Systems for Various Uses Electronic pneumatic, hydraulic control system and their application in Farm machinery, food processing industry aquaculture, milk processing

Total: 45 Hours

Reference(s)

1. Doeblin, D.O. "Measurement Systems; Application and Design". McGraw Hill, 1984
2. Considine T..M. "Process/Industrial Instruments and ControlsÃ‚Â· Handbook", McGraw Hill 1993
3. Fribance, A.E. "Industrial Instrumentation Fundamentals", McGraw Hill, 1962
4. Coughanowr, D.R. "Process Systems Analysis and Control", McGraw Hill, 1991
5. Patranabis. D. "Principles of Industrial Instrumentation", Tata McGraw Hill, 1995
6. Patranabis, D. "Principles of Process Control", Tata McGraw Hill, 1995

22AG033 DATABASE MANAGEMENT AND MICROPROCESSOR APPLICATIONS IN AGRICULTURE **3 0 0 3**

Course Objectives

- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques
- Impart knowledge on the methods of interfacing 8085 and 8086 microprocessors with various peripheral devices

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Execute knowledge on the methods of interfacing 8085 and 8086 microprocessors with various peripheral devices
2. Assess to master the basics of SQL and construct queries using SQL
3. Organize the modes of operations of I/O interface devices
4. Generate programs using the register set and instruction set of Programmable Interrupt Controller 8259A
5. Plan program logics using the register set and instruction set of Programmable Interrupt Controller 8259A

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	3	2	1	2	1	2	1	-	-	-	-	-	1	1	-
2	1	2	3	2	2	1	1	-	-	-	-	-	-	-	-
3	2	2	2	1	1	1	2	-	-	-	-	-	-	2	-
4	3	3	2	1	2	1	2	-	-	-	-	-	2	-	-
5	1	2	3	1	1	2	1	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

INTRODUCTION

Purpose of Database system - Views of data - data models, database management system three schema architecture of DBMS, components of DBMS, E/R Model - Conceptual data modelling -motivation, entities, entity types, attributes, relationships, relationship types, E/R diagram notification, examples.

UNIT II **9 Hours**

RELATIONAL MODEL

Relational Data Model - Concept of relations, scheme-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL, notion of aggregation, functions group by and having clauses, embedded SQL

UNIT III **9 Hours**

DATABASE DESIGN

Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong"s Axioms for FD"s, closure of a set of FD"s, minimal covers, definition of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF

UNIT IV **9 Hours**

PERIPHERAL DEVICES AND I/O INTERFACING

Programmable interrupt controller 8259A: Architecture and Signal description of 8259A - Command words of 8259A - operating models of 8259A - The Keyboard/Display controller 8279: Architecture and Signal Description of 8279 - Modes of Operations of 8279 - DMA Controller 8257: Internal Architecture and Signal Descriptions of a 8257 - DMA Transfers and Operations

UNIT V **9 Hours**

MICROCONTROLLER

Architecture of 8051 - Signal descriptions of 8051 - Register Set of 8051 - Memory Addressing - External I/O Interfacing -Addressing modes of 8051 - Instruction set of 8051

FOR FURTHER READING

Introduction to Parallel, Distributed and oriented databases -Introduction to MySQL and PHP

Total: 45 Hours

Reference(s)

1. A. Silberschatz, Henry F. Korth, and S. Sudharshan, "Database System Concepts", 5th Ed, Tata McGraw Hill, 2006
2. C. J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems" 8th ed, Pearson Education, 2006Raghu Ramakrishnan, "Database Management Systems", Thrid Edition, McGraw Hill, 2003
3. S. K. Singh,"Database Systems Concepts, Design and applications", First Edition, Pearson Education, 2oo6
4. Mohamed Ali Mazidi, Janice Gillispie Mazidi, The 8051 microcontroller and embedded systems, Pearson education, 2009.

22AG034 DATA ANALYTICS IN AGRICULTURAL SYSTEMS 3 0 0 3

Course Objectives

- Familiarize with the fundamentals of data science and related concepts
- Acquaint the students with the knowledge to construct complex statistical models, assess the fit of such models to the data, and apply the models in real-world contexts
- Apply quantitative modelling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.
PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Select the Implement data science fundamentals and apply them to day-to-day business and industrial needs
2. Assess appropriate probability and statistical tests using R
3. Execute supervised and unsupervised algorithms in the data analysis process
4. Design the mathematical models for data analysis and also perform mining in text data
5. Construct the visualization models using Tableau and d3.js tools

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	2	1	3	2	2	-	-	-	-	-	2	1	-
2	2	3	1	1	1	2	2	-	-	-	-	-	-	-	-
3	2	2	1	2	2	2	1	-	-	-	-	-	-	1	-
4	3	2	1	2	3	3	1	-	-	-	-	-	1	-	-
5	2	3	2	1	1	2	3	-	-	-	-	-	-	-	-

UNIT I **7 Hours**

INTRODUCTION TO DATA SCIENCE

Data Science Fundamentals, Exploring data engineering pipelines, Applying data science and data warehousing to business and industry

UNIT II **9 Hours**

INTRODUCTION TO PROBABILITY AND R

Introduction to Probability, Conditional Probability, Random Variable, Statistical Modelling, Probability Distribution, R Introduction, Data Structures in R, Working with Data in R

UNIT III **10 Hours**

SUPERVISED AND UNSUPERVISED LEARNING

Linear Regressions, Classification- Decision Tree, Naive Bayes, K-Nearest Neighbors, Clustering-Identifying Clusters, K-Means Clustering, Hierarchical Clustering

UNIT IV **10 Hours**

MATHEMATICAL MODELLING

Association Rule Mining, Time Series Analysis, Dimensionality Reduction, Principal Component Analysis, Linear Discriminant Analysis, Sentiment Analysis on text data

UNIT V **9 Hours**

VISUALIZATION TOOLS

Introduction to Visualization - Types of visualizations, Working with Tableau, Creating views in Tableau, using d3.js for data visualization

FOR FURTHER READING

Data Analysis using Python, Natural Language Processing, Google Charts.

Total: 45 Hours

Reference(s)

1. Lillian Pierson, Data Science for Dummies, John Wiley,2015
2. Garrett Grolemund, Hadley Wickham, R for Data Science, O Reilly in January 2017.
3. Andrie de Vries, Joris Meys, R For Dummies, John Wiley and Sons, 2012
4. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, Elsevier Inc., 2012.
5. David Baldwin , Mastering Tableau, Packt Publishing, 2016.

22AG035 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FOR AGRICULTURE

3 0 0 3

Course Objectives

- To impart artificial intelligence principles, techniques and its history
- To introduce basic concepts and techniques of Machine Learning
- To assess the applicability of AI and ML in Agriculture

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO11: 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.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Use basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
2. Implement machine learning algorithms to agricultural datasets for problem-solving
3. Select appropriate unsupervised learning models to address specific challenges in agriculture
4. Select and implement appropriate supervised learning models to address specific challenges in agriculture
5. Assess comprehensive pest management strategies, integrating AI-based approaches for pest detection, monitoring, and control and use of ML for agricultural application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	2	3	-	-	-	-	-	-	-	-	-	1
2	3	2	-	2	3	-	-	-	-	-	-	-	-	-	1
3	3	2	-	2	3	-	-	-	-	-	-	-	-	-	1
4	2	2	-	2	3	-	-	-	-	-	-	-	2	2	2
5	2	2	1	2	3	1	1	1	1	-	1	-	2	-	3

UNIT I **9 Hours**

INTRODUCTION TO AI - INTELLIGENT AGENT AND UNINFORMED SEARCH

Introduction – Foundations of AI – History of AI – The state of the art – Risks and Benefits of AI -Intelligent Agents– Nature of Environment – Structure of Agent – Problem Solving Agents -Formulating Problems – Uninformed Search – Breadth First Search – Dijkstra's algorithm or uniform-cost search – Depth First Search – Depth Limited Search

UNIT II **8 Hours**

INTRODUCTION TO MACHINE LEARNING

Need for Machine Learning, Machine Learning Explained, and Machine Learning with respect to agriculture, Types of Machine Learning. Challenges of Machine Learning, Machine Learning process, Machine Learning applications.

UNIT III **8 Hours**

UNSUPERVISED LEARNING

Unsupervised Learning – Principle Component Analysis – Neural Network: Fixed Weight Competitive Nets –Kohonen Self-Organizing Feature Maps – Clustering: Definition – Types of Clustering – Hierarchical clustering algorithms – k- means algorithm

UNIT IV **8 Hours**

SUPERVISED LEARNING

Neural Network: Introduction, Perceptron Networks – Adaline – Back propagation networks -Decision Tree: Entropy – Information gain – Gini Impurity – classification algorithm – Rule based Classification – Naive Bayesian classification – Support Vector Machines (SVM)

UNIT V **12 Hours**

APPLICATION OF AI AND ML FOR AGRICULTURE

Application of AI and ML for agriculture - Disease Classification - Pest detection and monitoring - Integrated pest management using AI - Early warning systems for pest outbreaks and Detection in Plants - Species Recognition in Flowers - Precision Farming - Use of ML For Portable Proximal Soil And Crop Sensors - Soil And Crop Image Processing - Digital Soil Mapping - General Overview - Digital Soil Mapping With Continuous Variables and Categorical Variables

Total: 45 Hours

Reference(s)

1. Peter Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012

2. Jason Bell, Machine learning Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014
3. Ethem Alpaydin, Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series, Third Edition, MIT Press, 2014
4. Stuart J. Russell, Peter Norvig, Artificial Intelligence - A Modern Approach, Third Edition, Pearson Publishers, 2015.

22AG036 MECHATRONICS IN AGRICULTURAL ENGINEERING **3 0 0 3**

Course Objectives

- Develop a comprehensive understanding of mechatronics principles and their application in agricultural engineering
- To learn about mechatronics systems and equipment used in agricultural engineering
- To Analyze and design mechatronics solutions for agricultural engineering problems
- Develop critical thinking and problem-solving skills in the context of mechatronics in agricultural engineering

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

1. Assess the mechatronic design approach to develop integrated systems in the field of agricultural engineering
2. Design the effective interfacing, instrumentation, and control systems for mechatronic applications in agricultural engineering
3. Assess the principles of Microprocessor based controllers and Microelectronics
4. Implement various control systems and their application in agricultural engineering
5. Execute the knowledge to choose suitable robot used for the agriculture purpose

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	-	-	-	1	-	-	-	-	-	-	-	3	-
2	2	2	3	-	-	1	-	-	-	-	-	-	-	3	-
3	2	2	3	1	-	1	-	-	-	-	-	-	-	3	-
4	2	2	3	1	-	1	-	-	-	-	-	-	-	3	-
5	2	3	2	-	-	-	-	-	-	-	-	-	-	3	-

UNIT I **9 Hours**

INTRODUCTION

Definition of mechatronics, measurement system, control systems, microprocessor-based controllers, mechatronics approach. Sensors and transducers, performance terminology, Displacement, Position & Proximity Sensors, photo-electric transducers, flow transducers, optical sensors and transducers

UNIT II **9 Hours**

MICROPROCESSOR CONTROL

System interfacing, instrumentation, and control systems. Input/output signals of a mechatronic system, signal conditioning, microprocessor control, microprocessor numerical control, microprocessor input/output control.

UNIT III **9 Hours**

MICROPROCESSOR BASED CONTROLLERS AND MICROELECTRONICS

Introduction to microelectronics, digital logic, overview of control computers, microprocessors and microcontrollers, programmable logic controllers, digital communications

UNIT IV **9 Hours**

TECHNOLOGIES OF ROBOT

Sub systems, transmission system (Mechanics), power generation and storage system, sensors, electronics, algorithms and software. Servo motor drives types and applications. Stepper motor and its concept. Industrial robots: Classification and sub systems. Defining work space area

UNIT V **9 Hours**

APPLICATION OF ROBOTS IN AGRICULTURE

Harvesting and picking, weed control, autonomous mowing, pruning, seeding, spraying and thinning, phenotyping, sorting and packing. Utility platforms. Use of different agro bots in agriculture.

FOR FURTHER READING

System modelling & control, Mathematical Models, Engineering Systems, Electro-mechanical & Hydraulic-mechanical Systems

Total: 45 Hours

Reference(s)

1. Alciatore DG and Histand MB. 2002. Introduction to Mechatronics and Measurement System. McGraw Hill Pvt Limited, New Delhi.
2. Robert HB. 2002. Mechatronic Hand Book. CRC Press.
3. Shakhatreh and Fareed. 2011. The Basics of Robotics. Lahti University of Applied Sciences Machine and Production Technology
4. Wolfram, Stadler. 1995. Analytical Robotics and Mechatronics. McGraw Hill Pvt Limited, New Delhi.
5. Bolton, W. 2010. Mechatronics. Pearson Education Asia

22AG037 GEOINFORMATICS AND NANO TECHNOLOGY **3 0 0 3**

Course Objectives

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

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.
PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

Course Outcomes (COs)

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

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	2	2	1	-	-	-	-	-	-	1	1	-
2	2	2	1	1	2	3	-	-	-	-	-	-	-	-	-
3	2	1	2	1	2	2	-	-	-	-	-	-	-	2	-
4	3	1	3	1	3	2	-	-	-	-	-	-	1	-	-
5	2	3	1	2	2	3	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

NANO SCALE MATERIALS

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

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

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

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

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

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

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

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-HEMT devices: structure, fabrication, principle, types and applications - organic LED: basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- single electron transistor-particulate and geometrical nanomagnets - spintronics

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6.

22AG038 AGRI BUSINESS MANAGEMENT AND ENTREPRENEURSHIP **3 0 0 3**

Course Objectives

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

Programme Outcomes (POs)

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO11: 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.

Course Outcomes (COs)

1. Assess the agribusiness situations, formulate strategies, implement plans and manage strategic change
2. Execute how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment
3. Analyze the process of managements four functions: planning, organizing, leading, and controlling
4. Resolve the various structure and technologies of the agribusiness sector to develop the business in the competitive marketing
5. Determine the systematic process to elect and ability to discern distinct entrepreneurial traits

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	-	1	-	-	-	-	-	1	2	-	3	-	-	-	-
2	-	2	1	-	1	-	-	-	1	-	1	-	-	-	-

3	-	1	2	-	-	-	3	3	-	-	1	-	-	-	-
4	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-
5	-	2	1	1	-	-	-	2	-	-	-	-	-	-	-

UNIT I **9 Hours**

AGRIBUSINESS MANAGEMENT

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

UNIT II **9 Hours**

MANAGEMENT FUNCTIONS

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

UNIT III **9 Hours**

FUNCTIONAL AREA - I

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

UNIT IV **9 Hours**

FUNCTIONAL AREA - II

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

UNIT V **9 Hours**

ENTREPRENEURSHIP

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

FOR FURTHER READING

Market survey for understanding client needs and satisfaction - Pricing methods for small agribusinesses

Total: 45 Hours

Reference(s)

1. Subba Reddy, S. and P. Raghu Ram. 2011. Agricultural Finance and Management. Oxford & IBH. New Delhi.
2. Muniraj, R. 1987. Farm Finance for Development. Oxford & IBH. New Delhi.
3. Lee, W.F., M.D. Boehlje, A.G. Nelson and W.G. Murray. 1998. Agricultural Finance.Kalyani Publishers. New Delhi
4. Patnaik, V.E. and A.K. Roy. 1988. Cooperation and Cooperative Management. Kalyani Publishers, Ludhiana.

22AG039 AGRICULTURAL FINANCE, BANKING AND COOPERATION **3 0 0 3**

Course Objectives

- To study the various methods of agriculture finance
- To reconstruct the policies and of co-operative so that it can bring about economic development of people

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO11: 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.

Course Outcomes (COs)

1. Implement confidence in the preparation and use of business accounts
2. Compute an opportunity to prepare, as part of their final management project, a thorough analysis of a business situation
3. Resolve the marketing linkages with centre to increase employment opportunities and generating income
4. Outline the Co-operation Philosophy and Principles as part of revitalizing cooperative credit
5. Check the financial inclusion and exclusion with assessment of crop losses.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
2	2	1	-	-	-	1	-	-	-	-	3	-	-	-	-
3	3	2	-	-	-	1	2	-	-	-	2	-	-	-	-
4	2	1	-	-	-	1	-	-	-	-	3	-	-	-	-
5	2	1	-	-	-	1	-	-	-	-	3	-	-	-	-

UNIT I **9 Hours**

AGRICULTURAL FINANCE - NATURE AND SCOPE

Agricultural Finance: Definition, Importance, Nature and Scope - Agricultural credit: Meaning, Definition, Need and Classification - Sources of credit - Role of institutional and non - institutional agencies - Rural indebtedness- Consequences of rural indebtedness Development of rural credit in India

UNIT II **9 Hours**

FARM FINANCIAL ANALYSIS

Principles of Credit - 5Cs, 3Rs and 7 Ps of Credit - Project Cycle and Management - Preparation of bankable projects / Farm credit proposals - Feasibility - Time value of money-Compounding and Discounting - Appraisal of farm credit proposals - Undiscounted and Discounted measures - Repayment plans - Farm Financial Statements- Balance Sheet, Income Statement and Cash Flow Statement - Financial Ratio Analysis

UNIT III **9 Hours**

FINANCIAL INSTITUTIONS

Institutional Lending Agencies - Commercial banks- Nationalization, Agricultural Development Branches- Regional Rural Banks, Lead bank, Scale of finance - Higher financial institutions- RBI, NABARD, AFC, ADB, World Bank and Deposit Insurance and Credit Guarantee Corporation of India - Microfinance and Its role in poverty alleviation - Self-Help Groups - Non-Governmental Organizations - Subsidized farm credit, Differential Interest Rate (DIR), Kisan Credit Card (KCC) Scheme - Relief Measures and Loan Waiver Scheme and Know Your Customer (KYC)

UNIT IV **9 Hours**

CO-OPERATION

Co-operation: Philosophy and Principles - History of Indian Co-operative credit movement: Pre and Post-Independence periods and Co-operation in different plan periods - Co-operative credit institutions-Two tier and three tier structure, Functions-provision of short term and long term credit, Strength and weakness of co-operative credit system, Policies for revitalizing co-operative credit - Successful co-operative credit systems in Gujarat, Maharashtra, Punjab, etc. - Special Co-operatives: LAMPS and FSS- Objectives, role and functions - National Cooperative Development Corporation (NCDC) and National Federation of State Cooperative Banks Ltd. (NAFSCOB): Objectives and functions

UNIT V **9 Hours**

BANKING AND INSURANCE

Meaning, Importance and Types - Central bank- RBI - functions - Credit control - Objectives and Methods: CRR, SLR and Repo rate - Credit rationing - Dear money and cheap money - Financial Inclusion and Exclusion: credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap - Non- Banking Financial Institutions (NBFI) - Assessment of crop losses, Determination of compensation - Crop Insurance Schemes - Livestock Insurance Schemes - Agricultural Insurance Company of India Ltd (AIC)

FOR FURTHER READING

Role of technology in finance and banking sector in India

Total: 45 Hours

Reference(s)

1. Subba Reddy, S. and P. Raghu Ram. 2011. Agricultural Finance and Management. Oxford & IBH. New Delhi.
2. Muniraj, R. 1987. Farm Finance for Development. Oxford & IBH. New Delhi.
3. Lee, W.F., M.D. Boehlje, A.G. Nelson and W.G. Murray. 1998. Agricultural Finance.Kalyani Publishers. New Delhi
4. Patnaik, V.E. and A.K. Roy. 1988. Cooperation and Cooperative Management. Kalyani Publishers, Ludhiana.

22AG040 TECHNOLOGY OF SEED PROCESSING 3 0 0 3

Course Objectives

- To acquire the knowledge on the various seed production and processing technologies
- To impart knowledge on seed testing and the methods
- To impart knowledge about seed certification, legislation and industries in India

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

Course Outcomes (COs)

1. Implement various technologies available in seed production
2. Organize the seed processing techniques and identify various seed processing equipment
3. Compare the different methods and procedure to test the seeds
4. Analyze the knowledge on certification and legislation in seed industries
5. Determine the growth of seed industry and their role in India

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	3	1	2	1	-	-	-	-	-	1	1	-	-
2	2	3	2	1	2	1	-	-	-	-	-	1	1	-	-
3	2	1	2	1	1	3	-	-	-	-	-	1	1	-	-
4	2	2	2	1	2	1	-	-	-	-	-	1	1	-	-
5	2	2	3	2	2	1	-	-	-	-	-	1	1	-	-

UNIT I **9 Hours**

SEED PRODUCTION TECHNOLOGY

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

UNIT II **9 Hours**

SEED PROCESSING TECHNOLOGY

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

UNIT III **9 Hours**

SEED TESTING

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

UNIT IV **9 Hours**

SEED CERTIFICATION AND LEGISLATION

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

UNIT V **9 Hours**

SEED INDUSTRY IN INDIA AND THEIR ROLE IN AGRICULTURAL DEVELOPMENT

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

UNIT VI **9 Hours**

FOR FURTHER READING: Ozone treatment of seeds

Total: 54 Hours

Reference(s)

1. J.F Harrington and J.E Douglas, Seed storage and packaging application, NSC, New Delhi, 1963
2. J.E Douglas, Seed Production Mannual, National Seeds Corporation and Rockfeller Foundation, New Delhi, 1969.
3. J.E Douglas, Seed Certification Mannual, National seeds corporation, New Delhi, 1970
4. B.R Gregg, A.G. Law, S.S Virdi and J.S Balis Seed Processing, National seed corporation, New Delhi, 1990
5. R.L Agrawal, A text book on Seed Technology, Oxford & IBH Publication, Co Pvt Ltd, New Delhi-1992
6. L.O Copeland and M.B Mc Donald, Principles of Seed Science and Technology Chapman and Hall, New York, 1995

22AG041 MUSHROOM CULTIVATION AND VERMICOMPOSTING **3 0 0 3**

Course Objectives

- To provide hands on training for preparing the mother culture (Spawn production).
- To study the various methods of mushroom cultivation.
- To provide the training for using appropriate technology, utilization of resources and suitable market strategy for mushroom production

Programme Outcomes (POs)

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design solutions for complex engineering problems and design system components or processes that meet PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO11: 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.

Course Outcomes (COs)

1. Execute the important of mushroom and how it can convert waste material into human food.
2. Organize the different methods of mushroom spawn production within a relatively small space
3. Analyze various types cultivation practices of mushroom under different agro climatic zones of Tamil Nadu and India
4. Compare the post harvest methods and value addition of mushroom for extend the shelf life
5. Determine the marketing linkages with centre to increase employment opportunities and generating income

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	-	1	-	-	-	-	-	-	2	-	1	-	-	-	-
2	-		-	-	-	-	-	-	3	-	1	-	-	-	-
3	-	1	-	-	-	1		1	2	-	3	-	-	-	-
4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

INTRODUCTION OF MUSHROOM

History of mushroom - Scope and Importance - Life cycle of mushroom - Area, Production, Productivity of mushroom in World, India and Tamil Nadu, Types of mushroom - Oyster mushroom - Paddy straw mushroom - Button mushroom - Milky mushroom - Shiitake mushroom - Other mushrooms - Different parts of a typical mushroom & variations in mushroom morphology.

UNIT II **9 Hours**

MOTHER SPAWN PRODUCTION

Mushroom growing technologies - Facilities required for spawn preparation, Preparation of spawn substrate, preparation of pure culture, media used in raising pure culture, culture maintenance, storage of spawn. - Growing conditions for mushrooms - Composting technology, mushroom bed preparation. Spawning, spawn running, harvesting. Cultivation of oyster and paddy straw mushroom

UNIT III **9 Hours**

PEST MANGEMENT AND POST HARVEST METHODS

Problems in cultivation - diseases, pests and nematodes, weed moulds and their management strategies. Post-harvest technology and value addition of mushroom

UNIT IV **9 Hours**

PEST MANGEMENT AND POST HARVEST METHODS

Pest and diseases of mushroom - Harvesting, storing and using mushrooms - post-harvest technology and value addition of mushroom

UNIT V **9 Hours**

VERMICOMPOST COLLECTION AND PRODUCTION TECHNIQUES

Waste material- Classification, segregation - processing- Bed preparation - earthworm collection and applications-Inspection of beds and watering - separation, air drying, sieving - storing

FOR FURTHER READINGS

Government policies and programmes for promotion of mushroom

Total: 45 Hours

Reference(s)

1. Mushroom Cultivation (Paperback, N. Revathy, A. Vijayasamundeeswari, V.M. Indumathi, V. Gomathi), Shanlax Publications, ISBN: 9789390082735, Edition: 1, 2020
2. V.N. Pathak, N. Yadav and M. Gaur. 2010. Mushroom production and processing technology. Published by Agrobios, Jodhpur
3. B.C. Suman and V.P.Sharma.2007. Mushroom cultivation in india. Daya Publishing House, New Delhi.179p
4. R.D. Rai and T. Arumuganathan (2008). Post-Harvest Technology of Mushrooms, Technical BulIetin 2008, NRCM, ICAR, Chambaghat, Solan1731213, (H.P.)
5. Anand B. Masthihole and L. Nalina (2016) Organic Farming. Agrimoon.Com

22AG042 ENGINEERING ECONOMY AND PROJECT PLANNING **3 0 0 3**

Course Objectives

- Demonstrate an understanding of Engineering Economy principles.
- Analyse problems that an engineer would encounter on the job site through the use of Engineering Economy techniques.
- Able to plan a project using the principles of project planning and management.

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: 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.
PO4: 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.
PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Find the importance, purpose of Planning and hierarchy of planning and analyze its types.
2. Compute decision making, Organizing, Staffing, Directing and Controlling.
3. Select the best economic model from various available alternatives.
4. Show various interest rate methods and implement the suitable one.
5. Integrate various depreciation values of commodities

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	1	3	-	-	-	2	2	-	-	-	-	-	-	-
2	-	2	3	-	-	-	2	2	-	-	-	-	-	-	-
3	2	2	3	2	-	2	2	-	-	-	-	-	-	-	-
4	2	2	3	3	3	2	-	-	-	-	-	-	-	-	-
5	-	2	3	3	3	1	-	-	-	-	-	-	-	-	-

UNIT I **10 Hours**
FUNDAMENTALS OF ECONOMICS
Wealth, Welfare and Scarce Definitions of Economics; Micro and Macro Economics; Demand- Law of Demand, Elasticity of Demand, Types of Elasticity and Factors determining price elasticity of Demand: Utility- Law of Diminishing Marginal Utility, its limitations and exceptions.

UNIT II **8 Hours**
FORMS OF BUSINESS ORGANIZATIONS
Features, merits and demerits of Sole Proprietorship, Partnership and Joint Stock Company- Public Enterprises and their types.

UNIT III **10 Hours**
HUMAN RESOURCE & PRODUCTION MANAGEMENT
Functions of Management- Taylor's Scientific Management; Henry Fayol's Principles of management; Human Resource Management –Basic functions of Human Resource Management (in brief). Production Management: Production Planning and Control, Plant Location, Break-Even Analysis- Assumptions, limitations and applications.

UNIT IV **9 Hours**
FINANCIAL MANAGEMENT
Types of Capital: Fixed and Working Capital and Methods of Raising Finance; Final Accounts- Trading Account, Statement of Profit and Loss and Balance Sheet (simple problems).

UNIT V **8 Hours**
MARKETING MANAGEMENT AND ENTREPRENEURSHIP:
Marketing Management: Functions of marketing and Distribution Channels. Entrepreneurship: Definition, Characteristics and Functions of an Entrepreneur

FOR FURTHER READING
Components of costs - estimation of selling price, marginal cost, first cost, all kinds of overheads - indirect cost estimation with depreciation - mensuration and estimation of material cost, cost estimation of mechanical process - idling time.

Total: 45 Hours

Reference(s)

1. Management Fundamentals - Concepts, Application, Skill Development - Robers Lusier - Thomson
2. Basics of Engineering Economy, Leland Blank & Anthony Tarquin, McGraw Hill Publication (India) Private Limited
3. Engineering Economics, R.Paneerselvam, PHI publication
4. Fundamentals of Management: Essential Concepts and Applications, Pearson Education, Robbins S.P. and Decenzo David A.
5. Economics: Principles of Economics, N Gregory Mankiw, Cengage Learning
6. Modern Economic Theory, By Dr. K. K. Dewett & M. H. Navalur, S. Chand Publications A.M. Michael, and T.P. Ojha, Principles of Agricultural Engineering Vol II Jain Brothers, New Delhi, 1980

22AG043 VALUE ADDITION OF INDIGENOUS FRUITS AND VEGETABLES

3 0 0 3

Course Objectives

- Understand Fruits and Vegetable Processing Techniques and its quality grading
- Analyse the methods of processing for value added products from fruits and vegetables through different methods
- Evaluate the conventional and modern packaging methods and quality control of value-added products

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

PSO2: Improvise technologies to minimize the crop loss from field damage during harvesting, sorting, processing, and packaging.

PSO3: Design improved irrigation gadgets and develop technologies for effective utilization of renewable energy in the agriculture sector.

Course Outcomes (COs)

1. Assess the trend and selection of raw materials in value-added products.
2. Assess the techniques involved in fruit and vegetable processing
3. Outline the quality and manufacturing techniques of fruit products
4. Outline the quality and manufacturing techniques of vegetable products
5. Analyse the conventional and modern packaging methods.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	2	-	-	-	-	-	-	-	-	2	-	-
2	2	2	2	2	-	-	-	-	-	-	-	-	2	-	-
3	2	3	2	2	-	-	-	-	-	-	-	-	2	-	-
4	3	2	2	2	-	-	-	-	-	-	-	-	2	-	-
5	3	2	3	3	-	-	-	-	-	-	-	-	3	-	-

UNIT I **9 Hours**

INTRODUCTION TO VALUE-ADDED PRODUCTS

Overview of Value-Added Processing – Definition and significance of value added products- Market trends and consumer demand for processed fruits and vegetables- Selection of raw materials – importance of quality and ripeness of fruits and vegetables- Heat treatment methods (blanching, pasteurization)

UNIT II **9 Hours**

PROCESSING TECHNIQUES

Canning– Introduction and Method; Drying techniques of fruits and vegetables – benefits and challenges; Maturity and ripening process – factors affecting ripening of fruits and vegetables- chemicals used for hastening and delaying ripening of fruits and vegetables; Freezing methods – benefits and challenges; Packaging consideration of frozen fruits and vegetables

UNIT III **9 Hours**

VALUE ADDED PRODUCTS FROM FRUITS

Value added products of mango – pulp, juice, concentrates, toffee, kernel flour; value added products of pineapple – canned pineapple, jam, vinegar, toffee; Value added products of grapes – wine, jelly, raisins.

UNIT IV **9 Hours**

VALUE ADDED PRODUCTS FROM VEGETABLES

Value added products of tomato – puree, paste, powder, sauce; Value added products from tuber crops- cassava flour, sago, starch; Value-added products of curcurbits – pumpkin seeds, cucumber pickles, bottle gourd tuty fruit, ash gourd petha. Minimally processed products and vegetable powders, plant based foods.

UNIT V **9 Hours**

PACKAGING AND QUALITY CONTROL OF VALUE ADDED PRODUCTS

Various methods of packaging-packaging materials and transport – packaging technology for export. Fabrication of type of containers, cushioning material, vacuum packaging, poly shrink packaging, specific packaging for value added fruits and vegetables; Quality analyses, standards and FSSAI specifications of fruits and vegetable products.

Total: 45 Hours

Reference (s)

1. Chakraverty, A, Arun S. Mujumdar, G.S.Vijayaraghavan, and Hosahalli. S. Ramaswamy. Handbook of Post Harvet Technology: Cereals, Fruits, Vegetables, Tea and Spices, Marcel Dekker. Inc. New York.2003
2. K.Sharma, Stevan J.Mulvaney and Syed S.H. Rizvi, Food Process Engineering-Theory and Laboratory equipments, John Wiley & Sons, New York, 2000.
3. Norman W. Desrosier, and James N. Desrosier. The Technology of Food Preservation 4th Edition, CBS Publisher & Distributions, New Delhi, 2004.
4. Siddappa, G.S. and Tendon, G. L. (2009). Preservation of Fruits and Vegetables. ICAR, Publications, New Delhi.
5. Srivastava, R.P. and Kumar, Sanjeev (2019). Fruit and Vegetable Preservation- Principles and Practices. 3rd Ed. CBS, Publishers, New Delhi

22AG044 PRINCIPLES OF ORGANIC FARMING 3 0 0 3

Course Objectives

- To Understand the Concept of Organic Farming.
- To Understand the Scope and Importance of Organic Farming.
- To Ensure Safe and Healthy Food production

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: 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.

PO4: 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.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Model, design, and analyze agricultural machinery and implement it to increase productivity, improve land use, and conserve agricultural inputs.

Course Outcomes (COs)

1. Execute the holistic concept organic farming as a system
2. Differentiate the cultural production practices typically employed in organic farming
3. Organize the challenges and trends in the production, processing, and marketing of organic farm products
4. Outline the large body of literature relating to organic agriculture
5. Determine and develop an organic production system

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	1	-	1	2	-	2	3	-	1	2	-	-
2	-	-	-	1	-	-	2	-	3	2	-	1	2	-	-

3	1	-	-	1	3	2	-	-	3	-	-	2	2	-	-
4	-	-	-	1	2	1	-	2		3	-	1	1	-	-
5	-	-	-	1	2	-	-	-	2	3	-	2	2	-	-

UNIT I **9 Hours**

FUNDAMENTALS OF ORGANIC FARMING

Introduction to organic farming: Definition, concepts, principles and objectives, characteristics - relevance to modern agriculture. Converting soil into organic. Basic concepts of cropping pattern, cropping system and farming system. Integrated Farming System

UNIT II **10 Hours**

ORGANIC FARMING INITIATIVES

Initiatives taken by the central and state governments-NGOs and other organizations for promotion of organic agriculture in India. Organic nutrient sources and their fortification - organic manures- methods of composting, Green manures- bio fertilizers - types, methods of application - benefits and limitations.

UNIT III **10 Hours**

ORGANIC ECOSYSTEM AND NUTRIENT MANAGEMENT

Nutrient use in organic farming-scope and limitations, Nutrient management in organic farming, Organic ecosystem and their concepts, Choice of crops and varieties in organic farming - crop rotations - need and benefits - multiple cropping

UNIT IV **10 Hours**

ORGANIC CROP AND PEST MANAGEMENT

Fundamentals of insect, disease and weed management under organic mode of production-cultural biological methods-non chemical pest - disease management. Botanicals- pyrethrum, neem seed kernel extract, neem seed - powder, soluble neem formulations, neem oil. Operational structure of NPOP - other agencies for organic production.

UNIT V **6 Hours**

ORGANIC CERTIFICATION

Inspection - certification - labelling and accreditation procedures for organic products. Processing - economic consideration and viability. Marketing and export potential of organic products - national economy

FOR FURTHER READING

Case studies of Indigenous Technical knowledge e (ITK) for nutrient, insect, pest, disease and weed management. Visit to organic farms to study the various components and their utilization

Total: 45 Hours

Reference(s)

1. Balasubramanian, R., Balakishnan, K and Siva Subramanian, K. 2013. Principles and practices of organic farming. Satish Serial Publishing House. 453p
2. Tarafdar, J.C., Tripathi, K.P and Mahesh Kumar, 2009. Organic agriculture. Scientific Publishers, India. 369p.
3. Tiwari, V.N., Gupta, D.K., Maloo, S.R and Somani, L.L. 2010. Natural, organic, biological, ecological and biodynamic farming. Agrotech Publishing Academy, Udaipur. 420p.
4. Mukund Joshi and Prabhakarasetty, T.K. 2006. Sustainability through organic farming. Kalyani publishers, New Delhi. 349p

22OCS01 OBJECT ORIENTED PROGRAMMING 3 0 0 3

Course Objectives

- Understand the concepts of Object-Oriented Programming
- Study the concepts of objects and classes.
- Familiarize in the types of constructors.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO3. Execute professional capabilities to competitively work in industries with global Standards by implementing recent tools and techniques.

Course Outcomes (COs)

1. Identify the characteristics and data types of C++ language.
2. Develop programs using objects and classes for real world applications
3. Construct programs to implement operator overloading and inheritance techniques
4. Apply Polymorphism and File streams concepts to develop C++ program
5. Design applications using templates and apply exception handling mechanisms

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	-	-	3	-	-	-	-	-	-	-	-	-	2
2	1	2	3	-	3	-	-	-	-	-	-	-	-	-	3
3	1	2	2	-	3	-	-	-	-	-	-	-	-	-	3
4	1	2	3	-	3	-	-	-	-	-	-	-	-	-	3
5	1	2	3	-	3	-	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**
INTRODUCTION
Need for object oriented programming - Procedural Languages vs. Object oriented approach - Characteristics Object oriented programming - C++ Programming Basics: Basic Program Construction - Output Using cout - Input with cin - Data types- Variables and Constants - Operators - Control Statements-Manipulators - Type conversion. Function Prototyping- call by reference, return by reference- Inline function- Default arguments - Function overloading.(sona)

UNIT II **9 Hours**
OBJECTS AND CLASSES
Objects and Classes Simple Class - C++ Objects as Physical Objects - C++ Object as Data types-CONSTRUCTORS: Parameterized Constructors - Multiple Constructors in a Class - Constructors with Default Arguments - Dynamic Initialization of Objects - Copy and Dynamic Constructors - Destructors(PSG) - Structures and Classes - Arrays and Strings

UNIT III **9 Hours**
OPERATOR OVERLOADING AND INHERITANCE
Operator Overloading and Inheritance Need of operator overloading- Overloading Unary Operators-Overloading binary Operators - Overloading Special Operators - Data Conversion Inheritance: Derived Class and Base Class - Derived Class Constructors-Overriding Member Functions-Class Hierarchies- Public and Private Inheritance-Levels of Inheritance-Multiple Inheritance.

UNIT IV **9 Hours**
POLYMORPHISM AND FILE STREAMS
Polymorphism and File Streams Virtual Function - Friend Function - Static Function-Assignment and Copy Initialization- Memory Management: new and delete Pointers to Objects, this Pointer-Streams - String I/O - Character I/O - Object I/O - I/O with Multiple Objects - File Pointers - Disk I/O with Member Functions- Error Handling in File I/O.

UNIT V **9 Hours**
TEMPLATES AND EXCEPTION HANDLING
Templates: Introduction - Function Templates - Overloading Function Templates-, user defined template arguments(sona) - Class Templates - Exception Handling - Syntax, multiple exceptions, exceptions with arguments.

Total: 45 Hours

Reference(s)

1. Deitel & Deitel, C++ How to program, Prentice Hall,2005.
2. Robert Lafore, Object Oriented Programming in-C++, Galgotia Publication.
3. D.S.Malik, C++ Programming, Thomson, 2007.
4. K.R. Venugopal, Rajkumar and T.Ravishankar, Mastering C++, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2006.
5. E.Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill Publishing.

22OCS02 JAVA FUNDAMENTALS 3 0 0 3

Course Objectives

- Implement applications based on core Java Concepts with examples
- Construct application using inheritance, packages and exception handling for real time problems.
- Integrate the Java I/O concepts to handle input and output operations.
- Develop programs to perform string manipulation in java.
- Design GUI with Java for event handling and database applications.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO3. Execute professional capabilities to competitively work in industries with global Standards by implementing recent tools and techniques.

Course Outcomes (COs)

1. Demonstrate applications based on core Java Concepts with examples
2. Construct application using inheritance, packages and exception handling for real time problem
3. Explain the Java I/O concepts to handle input and output operations.
4. Develop programs to perform string manipulation in Java.
5. Design GUI with Java for event handling and database applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	-	2	-	-	-	-	-	-	-	-	-	2
2	2	3	2	-	2	-	-	-	-	-	-	-	-	-	2
3	3	3	3	-	3	-	-	-	-	-	-	-	-	-	3
4	2	2	2	-	2	-	-	-	-	-	-	-	-	-	2
5	2	2	2	-	2	-	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

BASICS OF JAVA

The Genesis of Java - Overview of Java - Data Types, Variables, and Arrays - Operators – Control Statements - Introducing Classes - Methods and Classes.

UNIT II **9 Hours**

INHERITANCE, PACKAGES AND EXCEPTIONS

Inheritance: Basics - Using Super - Creating a Multilevel Hierarchy - Method overriding - Using Abstract Classes - Packages and Interfaces: Packages - Access Protection - Importing Packages- Interfaces Definitions and Implementations - Exception Handling: Types - Try and Catch - Throw.

UNIT III **9 Hours**

EXPLORING JAVA I/O

I/O Basics - Reading Console Input -Writing Console output - Native Methods - I/ O Classes and Interfaces - File - The Byte Streams - The Character Streams - Using Stream I/ O - Serialization.

UNIT IV **9 Hours**

JAVA STRINGS

String Handling: Special String operations and Methods - String Buffer - Exploring java.lang: Simple type Wrappers - System - Math - Collections Framework: Collections Interfaces and Classes – Utility Classes: String Tokenizer - Date and Time.

UNIT V **9 Hours**

GUI WITH JAVA

Applet Basics - Applet Architecture - Applet Display Methods - Parameter Passing - Event Handling Mechanisms - Event Classes - Event Listener - Working with Windows, Graphics, Colors and Fonts - AWT Controls - Layout Managers and Menus – JDBC

Total: 45 Hours

Reference(s)

1. Herbert Schildt, Java 2-Complete Reference, Tata Mc Graw Hill, 2015.
2. Deitel & Deitel, Java How to Program, Prentice Hall of India, 2010.
3. Gary Cornell and Cay S.Horstmann, Core Java Vol.1 and Vol.2, Sun Microsystems Press, 2008.

22OCS03 KNOWLEDGE DISCOVERY IN DATABASES

3 0 0 3

Course Objectives

- Introduce the basic concepts of data warehousing.
- Impart knowledge about the data mining functionalities.
- Assess the strengths and weaknesses of association mining and cluster analysis.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PSO3. Execute professional capabilities to competitively work in industries with global Standards by implementing recent tools and techniques.

Course Outcomes (COs)

1. Explain the concepts of Data Warehousing architecture and business analysis process.
2. Illustrate the process of Data Mining and preprocessing techniques for data cleansing.
3. Apply the association rules for mining the various kinds of data
4. Analyze Classification and Clustering algorithms for various problems with high dimensional data.
5. Illustrate the various data mining techniques on complex data objects

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
2	2	3	2	-	-	-	-	-	-	-	-	-	-	-	2
3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
4	3	2	2	2	-	-	-	-	-	-	-	-	-	-	2
5	2	2	2	2	-	-	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

DATA WAREHOUSING AND BUSINESS ANALYSIS

Data warehousing Components -Building a Data warehouse -Data Warehouse and DBMS-Metadata-Multidimensional data model - Data Extraction, Cleanup and Transformation Tools - Reporting, Query tools and Applications - OLAP vs OLTP - OLAP operations - Data Warehouse Schemas: Stars, Snowflakes and Fact constellations.

UNIT II **8 Hours**

INTRODUCTION TO DATA MINING

Introduction - Steps in knowledge discovery from databases process - Architecture of a Typical Data Mining Systems - Data Mining Functionalities - Classification of Data Mining Systems - Data mining on different kinds of data - Different kinds of pattern - Task Primitives - Integration of a Data Mining System with a Data Warehouse - Major issues in Data mining.

UNIT III **9 Hours**

ASSOCIATION RULE MINING

Market Basket Analysis- Frequent Item Set Mining methods: Apriori algorithm - Generating Association Rules - A Pattern Growth Approach- Pattern mining in multilevel and multidimensional space - Mining Various Kinds Of Association Rules - Association Analysis to Correlation Analysis - Constraint Based Association Mining.

UNIT IV **9 Hours**

CLASSIFICATION AND CLUSTERING

Decision Tree Induction - Bayesian Classification - Rule Based Classification - Classification by Back propagation - Support Vector Machines - Clustering: Types of data - Partitioning methods: k-means, k- medoid - Hierarchical Methods: distance based agglomerative and divisible clustering, BIRCH – Density Based Method: DBSCAN - Grid Based Method: STING.

UNIT V **10 Hours**

DATA MINING APPLICATIONS

Mining complex data objects - Text Mining - Graph mining - Web mining - Spatial Data mining -Application and trends in data mining - Social impacts of Data mining.

Total: 45 Hours

Reference(s)

1. Jiawei Han, Micheline Kamber and Jian Pai , Data Mining: Concepts and Techniques, Morgan Kauffman, 3rd Edition, 2013.
2. Alex Berson and Stephen J Smith, Data Warehousing, Data Mining, and OLAP, Tata Mcgraw- Hill, 1997.
3. David Hand, Heikki Manila, Padhraic Symth, Principles of Data Mining, MIT Press, 2001.
4. Margaret H.Dunham, Data Mining: Introductory and Advanced Topics, Pearson Education 2003.

22OCS04 E LEARNING TECHNIQUES 3 0 0 3

Course Objectives

- Understand the technologies involved in e-learning.
- Gain the fundamentals of e-learning techniques
- Determine the characteristics of Teaching-Learning Process

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PSO3. Execute professional capabilities to competitively work in industries with global Standards by implementing recent tools and techniques

Course Outcomes (COs)

1. Acquire knowledge about the basic concepts of e-learning.
2. Explain the technology mediated communication in e-learning
3. Exemplify of e-learning and content the process management.
4. Analyze the teaching and learning processes in e-learning environment.
5. Assess the various applications of e-learning.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	2
2	2	2	3	-	-	-	-	-	-	-	-	-	-	-	2
3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
4	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
5	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

INTRODUCTION

Evolution of Education - Generations of Distance Educational Technology - Role of E-Learning - Components of e-learning: CBT, WBT, Virtual Classroom - Barriers to e-Learning Roles and Responsibilities: Subject Matter Expert - Instructional Designer - Graphic Designer - Multimedia Author - Programmer - System Administrator - Web Master

UNIT II **9 Hours**

TECHNOLOGIES

Satellite Broadcasting - Interactive Television - Call Centers - Whiteboard Environment - Teleconferencing: Audio Conferencing - Video Conferencing -Computer Conferencing. Internet: E-mail, Instant Messaging, Chat, Discussion Forums, Bulletin Boards, Voice Mail, File Sharing, Streaming Audio and Video.

UNIT III **9 Hours**
MANAGEMENT
Content: E-Content, Dynamic Content, Trends - Technology: Authoring, Delivery, Collaboration - Services: Expert Service, Information Search Service, Knowledge Creation Service - Learning Objects and E-Learning Standards. Process of E-Learning: Knowledge acquisition and creation, Sharing of knowledge, Utilization of knowledge - Knowledge Management in E-Learning.

UNIT IV **9 Hours**
TEACHING-LEARNING PROCESS
Interactions: Teacher-Student - Student-Student - Student-Content - Teacher- Content - Teacher-Teacher - Content-Content Role of Teachers in E-Learning - Blended Learning -Cooperative Learning - Collaborative Learning - Multi Channel learning -Virtual University - Virtual Library.

UNIT V **9 Hours**
APPLICATIONS
Customer service training - Sales training - Customer training - Safety training - IT training – Product training - Healthcare training.

Total: 45 Hours

Reference(s)

1. E-Learning: An Expression of the Knowledge Economy, Gaurav Chadha, S.M. Nafay Kumail, Tata McGraw-Hill Publication, 2002.
2. E-Learning: New Trends and Innovations, P.P. Singh, Sandhir Sharma, Deep & Deep Publications, 2005. 4. 4. Michael Allen's Guide to E-Learning, Michael W. Allen, Michael Allen, Wiley Publication, 2002
3. E-Learning: Concepts, Trends and Applications, Epignosis LLC, LLC publications, 2014.
4. Michael Allen's Guide to E-Learning, Michael W. Allen, Michael Allen, Wiley Publication, 2002.

3 0 0 3

22OCS05 SOCIAL TEXT AND MEDIA ANALYTICS

Course Objectives

- Understand the basic ideas of Text mining.
- Analyze the methods and approaches used in analytics.
- Gain knowledge on various types of analytics like web, social network, and social media

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO4. 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.
PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO3. Execute professional capabilities to competitively work in industries with global Standards by implementing recent tools and techniques

Course Outcomes (COs)

1. Demonstrate the concepts and applications of text mining
2. Explain Content analysis and Sentiment analysis
3. Illustrate web analytics with a suitable model
4. Illustrate social network analytics with suitable example.
5. Illustrate social media analytics with suitable example.

Articulation Matrix

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

UNIT I **7 Hours**
TEXT MINING
Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction, Text mining applications.

UNIT II **9 Hours**
METHODS
Content Analysis-Natural Language Processing-Clustering & Topic Detection-Simple Predictive Modeling-Sentiment Analysis; Sentiment Prediction.

UNIT III **9 Hours**
WEB ANALYTICS
Web analytics tools-Clickstream analysis-A/B testing, online surveys-Web search and retrieval-Search engine optimization-Web crawling and Indexing-Ranking algorithms-Web traffic models.

UNIT IV **10 Hours**
SOCIAL NETWORK ANALYTICS
Social contexts: Affiliation and identity - Social network analysis - Social network and web data and methods. Graphs and Matrices - Basic measures for individuals and networks

UNIT V **10 Hours**
SOCIAL MEDIA ANALYTICS
Information visualization - Making connections: Link analysis - Random graphs and network evolution.

Total: 45 Hours

Reference(s)

1. Ronen Feldman and James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, 2006.
2. Hansen, Derek, Ben Sheiderman, Marc Smith. Analyzing Social Media Networks with NodeXL: Insights from a Connected World, Morgan Kaufmann, 2011.
3. Avinash Kaushik. Web Analytics 2.0: The Art of Online Accountability, 2009.
4. Hanneman, Robert and Mark Riddle. Introduction to Social Network Method, 2005.
5. Wasserman, S. & Faust, K. Social network analysis: Methods and applications. New York: Cambridge University Press, 1994.
6. Monge, P. R. & Contractor, N. S. Theories of communication networks. New York: Oxford University, 2003

22OEC01 BASICS OF ANALOG AND DIGITAL ELECTRONICS

3 0 0 3

Course Objectives

- Understand the working of diodes and transistors in electronic circuits.
- Understand the analog operational amplifier and its applications.
- Understand the implementation of combinational and sequential circuits in digital systems.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PSO3. Execute professional capabilities to competitively work in industries with global Standards by implementing recent tools and techniques

Course Outcomes (COs)

1. Apply the diodes and transistors in regulators and amplifiers and analyze their characteristics.
2. Illustrate the working of analog IC with different configurations and its applications.
3. Simplification of Boolean expressions using K-map and implementation of combinational circuits.
4. Analyze the Flip flops and memory configurations in digital circuits.
5. Classify and analyze A/D and D/A converters with its parameters.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2
2	-	3	1	-	-	-	-	-	-	-	-	-	-	-	2
3	-	-	2	-	1	-	-	-	-	-	-	-	-	-	2
4	-	-	2	-	3	-	-	-	-	-	-	-	-	-	2
5	-	-	3	-	2	-	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

SEMICONDUCTORS DEVICES

Conductor, Semiconductors & Insulators, Semiconductors: intrinsic & extrinsic, energy band diagram - Mobility - Electrons and holes - The P-N junction diode - Zener diode - Avalanche effect- Rectifier Circuits Half wave, Full wave circuits, Efficiency, PIV, Ripple factor and AC and DC current and voltage in rectifier. PNP and NPN Bipolar junction Transistors - H parameters equivalent circuit - Common emitter amplifier - DC behavior: the load slope and the Q point - AC behavior - Emitter follower amplifier - Field effect transistors: JFET and MOSFET.

UNIT II **9 Hours**

OPERATIONAL AMPLIFIERS: DC PERFORMANCE

The operational amplifier - Input resistance, Output resistance, Open loop gain - Bias currents - Offset currents - Offset voltage - Differential mode gain - Common mode gain - Common mode rejection ratio - Negative feedback - Open loop gain and closed loop gain - Inverter amplifier - Non-inverter amplifier - The voltage follower - Transimpedance amplifier (Current to voltage converter) - Differential amplifier. Adders, Subtractors, Comparator, Integrator and Differentiator.

UNIT III **9 Hours**

DIGITAL TECHNIQUES: COMBINATIONAL CIRCUITS

Numbering systems - Binary, octal and hexadecimal numbers - Boole algebra - Conversion and operations - AND gate- OR gate - Inverter - NAND gate - NOR gate - Exclusive OR gate. Morgans laws. Combinational Circuits: Truth tables, logic expressions, Logic simplification using K- map, half and full adder/subtractor, multiplexers, demultiplexers, Logic families :TTL and CMOS.

UNIT IV **9 Hours**

DIGITAL TECHNIQUES: SEQUENTIAL CIRCUITS

Gated Latches & Flip Flops- Level triggered and Edge triggered Flip-Flops, Flop (FF) types: RS type. JK FF. JK FF Master slave. D FF. T FF. Flip Flop Conversion. Shift registers, Counters. Memories Structure: address and data bus. ROM, PROM, EPROM and flash RAM. Volatiles Memories: RAM, SRAM, DRAM. Addressing modes.

UNIT V **9 Hours**

DIGITAL TO ANALOG CONVERTERS AND ANALOG TO DIGITAL CONVERTERS

DIGITAL TO ANALOG CONVERTERS : Input latch. Binary Weighted Resistor Network. R-2R Ladder Resistor Network. Pulse Width Modulation . Resolution. Accuracy. Linearity. Zero Offset. Settling Time. Glitches. ANALOG TO DIGITAL CONVERTERS: Sampling. Real time sampling and equivalent time sampling. Sampling frequency. Sampling theorem (Nyquist). Anti-aliasing filtering. Sampling and holding. Conversion.

Total: 45 Hours

Reference(s)

1. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education,2012.
2. J Millman, C. Halkias & Satyabrata Jit, Electronic Devices and Circuits, Tata McGraw-Hill,2010.
3. Ramakant A.Gayakwad, OP-AMP and Linear IC"s , Prentice Hall of India, 2002.
4. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
5. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015.
6. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011.

22OEC02 MICROCONTROLLER PROGRAMMING 3 0 0 3

Course Objectives

- Understand Series of Microcontrollers in terms of architecture, Programming and Interfacing.
- Learn Programming of PIC series of microcontrollers and learn building of hardware circuits using PIC 16F series of Microcontrollers
- Learn the emerging trends in the design of advanced Microcontrollers.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO3. Execute professional capabilities to competitively work in industries with global Standards by implementing recent tools and techniques

Course Outcomes (COs)

1. Interpret the components and functionalities of 8051 Microcontrollers.
2. Develop microprocessor applications using the Assembly Language Program
3. Illustrate the working nature of PIC microcontroller on various versions
4. Illustrate the interfacing of different peripherals using PIC Microcontroller
5. Analyze the architecture and instruction set of ARM Microcontroller

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2
2	-	3	1	-	-	-	-	-	-	-	-	-	-	-	2
3	-	-	2	-	1	-	-	-	-	-	-	-	-	-	2
4	-	-	2	-	3	-	-	-	-	-	-	-	-	-	2
5	-	-	3	-	2	-	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

8-BIT MICROCONTROLLER

Introduction-Intel 8051 architecture-Counters and Timers-Serial Interface- Interrupts- Interfacing to external memory and 8255- Instruction set- Address modes.

UNIT II **9 Hours**

8051 ALP AND APPLICATIONS

Assembly language program- Timers and Counters programming- DAC- ADC- Sensor- Keyboard and LCD.

UNIT III **9 Hours**

PIC MICROCONTROLLER

PIC Microcontroller features- PIC Architecture, Program Memory, Addressing Modes, Instruction Set, Instruction Format- Byte-oriented Instructions- Bit-oriented Instructions- Literal Instructions- Control Instructions (CALL & GOTO)- Destination Designator. MPLAB overview: Using MPLAB, Toolbars, Select Development Mode and Device type, Project, Text Editor, Assembler, MPLAB operations.

UNIT IV **9 Hours**

PIC HARDWARE

Reset, Clock, Control registers, Register banks, Program Memory Paging, Ports, Interrupts, Timer and Counter, Watchdog Timer, Power up timer, Sleep mode, I2C bus- A/D converter.

UNIT V **9 Hours**

HIGH PERFORMANCE RISC ARCHITECTURE

ARM: The ARM architecture- ARM organization and implementation- The ARM instruction set- The THUMB instruction set- Basic ARM Assembly Language Program- ARM CPU Cores.

FOR FURTHER READING

Introduction- Architecture- Registers- Memory- Instruction set- Addressing Modes- I/O Pins- Timers- Counters- Interrupts.

Total: 45 Hours

Reference(s)

1. Ayala, Kenneth, "The 8051 Microcontroller", Thomson, 3rd Edition, 2004.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, " The 8051 Microcontroller and Embedded Systems", Person Education, 2nd Edition, 2004.
3. John B.Peatman, "Design with Microcontrollers", Person Education", 1st Edition, 2004.
4. Steave Furber, "ARM system-on-chip architecture" Addison Wesley, 2nd Edition, 2000.
5. A.V.Deshmukh, "Microcontrollers: Theory and Applications", Tata Mc Graw Hill, 12th reprint, 2005.

22OEC03 PRINCIPLES OF COMMUNICATION SYSTEMS

3 0 0 3

Course Objectives

- To study the various analog and digital modulation techniques
- To study the various digital communication techniques
- To enumerate the idea of spread spectrum modulation
- To study the design concepts of satellite and optical communication

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PSO3. Execute professional capabilities to competitively work in industries with global Standards by implementing recent tools and techniques

Course Outcomes (COs)

1. Illustrate the process involved in Amplitude, Frequency and phase modulation systems.
2. Analyze the performance of different digital modulation /demodulation techniques.
3. Analyze Pulse Code Modulation scheme for the transmission of analog data in digital format.
4. Apply the concepts of spread spectrum modulation techniques to eradicate interference in wireless communication.
5. Analyze the system design of satellite and optical communication.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
4	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

FUNDAMENTALS OF ANALOG COMMUNICATION

Principles of amplitude modulation, AM envelope, frequency spectrum and bandwidth, modulation index and percent modulation, AM Voltage distribution, AM power distribution, Angle modulation. FM andPM waveforms, phase deviation and modulation index, frequency deviation and percent modulation,Frequency analysis of angle modulated waves. Bandwidth requirements for Angle modulated waves

UNIT II **9 Hours**

DIGITAL COMMUNICATION

Introduction, Shannon limit for information capacity, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) Minimum Shift Keying (MSK),Phase Shift Keying (PSK), BPSK, QPSK, 8 PSK Quadrature Amplitude Modulation (QAM), Bandwidth Efficiency,Comparison of various Digital Communication System (ASK - FSK - PSK - QAM).

UNIT III **9 Hours**

DIGITAL TRANSMISSION

Introduction, Pulse modulation, PCM , PCM sampling, sampling rate, signal to quantization noise rate,companding, delta modulation, adaptive delta modulation, differential pulse code modulation, pulse transmission, Intersymbol interference, eye patterns.

UNIT IV **9 Hours**

SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES

Introduction, Pseudo-noise sequence, DS spread spectrum with coherent binary PSK, processing gain, FH spread spectrum, multiple access techniques, wireless communication, TDMA and CDMA in wireless communication systems, source coding of speech for wireless communications.

UNIT V **9 Hours**

SATELLITE AND OPTICALCOMMUNICATION

Satellite Communication Systems-Keplers Law,LEO and GEO Orbits, footprint, Link model-OpticalCommunication Systems-Elements of Optical Fiber Transmission link, Types, Losses, Sources and Detectors.

Total: 45 Hours

Reference(s)

1. Wayne Tomasi, Advanced Electronic Communication Systems, 6/e, Pearson Education, 2007.
2. Simon Haykin, Communication Systems, 4th Edition, John Wiley & Sons., 2001.
3. H.Taub,D L Schilling,G Saha ,Principles of Communication,3/e,2007.
4. B.P.Lathi,Modern Analog And Digital Communication systems, 3/e, Oxford University Press, 2007
5. Dennis Roddy, "Satellite Communications", Third Edition, Mc Graw Hill International Editions, 2001.
6. Gerd Keiser, Optical Fiber Communication, McGraw-Hill International, Singapore, 4th edition., 2011.

22OEC04 PRINCIPLES OF COMPUTER COMMUNICATION AND NETWORKS

3 0 0 3

Course Objectives

- To understand the concept of data communication and networking models.
- To study the various networking Components and Networks.
- To explore the routing, addressing and security and management aspects of computer networks.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO4. 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.
PSO3. Execute professional capabilities to competitively work in industries with global Standards by implementing recent tools and techniques

Course Outcomes (COs)

1. Classify the types of computer networks and analyze the seven layers of OSI model.
2. Analyze the basic operations of Routing Algorithms and Routing devices
3. Analyze the local and wide area networking technologies.
4. Apply the ISDN and ATM interface connections in broadband networks.
5. Analyze the security and management techniques related with networks.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	2	1	1	-	-	-	-	-	-	-	-	-	-	2
2	1	2	2	3	-	-	-	-	-	-	-	-	-	-	2
3	1	1	2	3	-	-	-	-	-	-	-	-	-	-	2
4	1	1	3	-	-	-	-	-	-	-	-	-	-	-	2
5	1	2	3	3	-	-	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

NETWORK FUNDAMENTALS

Types of Computer Networks: by Area, by Topology ; Communication Services: Serial and Parallel, Synchronous and Asynchrounous, Simplex and Duplex, Analog and Digital; Speed and Capacity; Multiplexing and Switching; Network Architecture: OSI Seven-Layer Network model.

UNIT II **9 Hours**

INTERNETWORKING AND COMPONENTS

Routing Concepts: Routing Algorithms, RIP, RIP-2, OSPF and other routing Protocols; Switches and Hubs: Store and Forward Switch, Cut-Through Switch,Hybrid Switch, Performance of Switches ; Repeaters; Repeater Vs Hubs; Bridges: Standards, Bridges Vs Repeaters; Routers and Gateways.

UNIT III **9 Hours**

LOCAL AND WIDE AREA NETWORKING TECHNOLOGIES

LAN Components and Topologies; Access Techniques; Transmission Protocols and Media; Ethernet and IEEE 802.3 Networks: History, 10-MBPS Ethernet, Switched Ethernet, 100-MBPS Ethernet, Gigabit Ethernet.

UNIT IV **9 Hours**

BROADBAND NETWORKS

ISDN: Evolution, ISDN Channel and Interface Structures; Broadband ISDN: Basics, Principles and General Architecture; Asynchronous Transfer Mode(ATM): Introduction, Concepts, Components, Connection Supported by ATM network and Concept of Virtual Channel and Virtual Path, Traffic control and Congestion Control, Operation and Maintenance aspects.

UNIT V **9 Hours**

NETWORK SECURITY AND MANAGEMENT

Security: Need of Security, Security Threats, Vulnerabilities, Methods, tools and Techniques for Attacks; Network Security: Levels of Security, Cryptosystems; Data Encryption Standard (DES), Public Key Cryptography, Firewalls; Network Management: Functions and Elements, Distribution of Management; Simple Network Management Protocol (SNMP), Remote Network Management Services.

Total: 45 Hours

Reference(s)

1. Michael A.Gallo, William M. Hancock, Computer Communications and Networking Technologies, 1 Ed, Thomson Learning, 2002.
2. Kenneth C. Mansfield, Jr.James L. Antonakos, An Introduction to Computer Networking, 1Ed, Prentice Hall of India, 2002
3. A Shanmugam, S Rajeev, Computer Communication Networks, 1Ed, ISTE Learning Materials Centre, 2001
4. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schafer, 3rd edition, 2010, Prentice Hall
5. Digital Signal Processing by Sanjit Mitra, 4th edition, 2011, McGraw-Hill, New York, NY

22OEI03 FUNDAMENTALS OF VIRTUAL INSTRUMENTATION 3 0 0 3

Course Objectives

- Understand the basic components of Virtual Instrumentation system.
- Learn the developing VIs based on Lab VIEW software.
- To learn to develop applications based on Virtual Instrumentation system.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO4. 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.
PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO10. 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.
PO11. 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.
PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO3. Execute professional capabilities to competitively work in industries with global Standards by implementing recent tools and techniques

Course Outcomes (COs)

1. Outline the concepts of traditional instruments and virtual instruments
2. Conclude the overview of modular programming and the structuring concepts in VI programming
3. Attribute the procedure to install DAQ in various OS and its interfacing methods
4. Implement the VI toolsets for specific applications
5. Generate the applications using Virtual Instrumentation software

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2
2	3	3	2	2	2	-	-	-	-	2	2	2	-	-	2
3	2	2	2	1	-	-	-	-	-	-	-	-	-	-	2
4	3	3	3	1	2	-	-	-	-	1	2	2	-	-	2
5	3	2	2	1	2	-	-	-	-	1	2	2	-	-	2

UNIT I **9 Hours**

INTRODUCTION

Virtual Instrumentation: Historical perspective - advantages - block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II **9 Hours**

VI PROGRAMMING TECHNIQUES

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT III **9 Hours**

DATA ACQUISITION

Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. Latest ADCs, DACs, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Data acquisition cards with serial communication - VI Chassis requirements. SCSI, PCI, PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

UNIT IV **9 Hours**

VI TOOLSETS

Use of Analysis tools, Fourier transforms, power spectrum, correlation methods, windowing and filtering. Application of VI in process control designing of equipments like oscilloscope, Digital multimeter, Design of digital Voltmeters with transducer input Virtual Laboratory, Web based Laboratory.

9 Hours

UNIT V

APPLICATIONS

Distributed I/O modules- Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

Total: 45 Hours

Reference(s)

1. Lisa K. wells & Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersey,1997.
2. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.
3. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newness, 2000.

22OEI04 OPTOELECTRONICS AND LASER INSTRUMENTATION 3 0 0 3

Course Objectives

- To enhance the student knowledge in fiber optics fundamentals and fabrication
- To be recognized with industrial applications of fibers
- To understand the fundamental concepts about lasers
- To identify and describe various fiber optic imaging and optoelectronic sensor applications

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Attribute the properties of optical fibers, their light sources and detectors.
2. Implement the fiber-optic sensor for the measurement of various physical quantities.
3. Conclude the fundamentals of laser, types of laser and its working.
4. Outline the applications of laser for industrial applications.
5. Differentiate the use of laser instruments for various medical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2
2	3	2	1	2	-	-	-	-	-	-	-	-	-	-	2
3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2
4	3	2	2	2	-	-	-	-	-	-	-	-	-	-	2
5	3	2	2	2	-	-	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

OPTICAL FIBERS AND THEIR PROPERTIES

Introduction to optical fibers - Light guidance - Numerical aperture - Dispersion - Different types of fibers and their properties - Light Sources for fiber optics, Photo detectors, source coupling, splicing and connectors.

UNIT II **9 Hours**

INDUSTRIAL APPLICATION OF OPTICAL FIBERS

Fiber optics instrumentation system - optical fiber sensors, Measurement of pressure, temperature, current, voltage and liquid level - fiber optic communication set up - different types of modulators - detectors.

UNIT III **9 Hours**

LASER FUNDAMENTALS

Fundamental characteristics of lasers: laser rate equation - three level system - four level system - properties of laser beams - laser modes - resonator configuration - Q- switching and mode locking - cavity dumping - types of lasers: gas lasers, solid state lasers, liquid lasers and semiconductor lasers.

UNIT IV **9 Hours**

INDUSTRIAL APPLICATION OF LASERS

Lasers for measurement of distance and length, velocity, acceleration, atmospheric effects, sonic boom, pollutants - material processing: laser heating, melting, welding and trimming of materials - removal and vaporization - calculation of power requirements of laser for material processing.

UNIT V **9 Hours**

HOLOGRAM AND MEDICAL APPLICATIONS

Holography: basic principle, methods - holographic interferometry and application, holography for non-destructive - medical applications of lasers, laser and tissue interactive - laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

Total: 45 Hours

Reference(s)

1. John M. Senior, Optical Fiber Communications - Principles and Practice, Prentice Hall of India, 2010.
2. John F. Ready, Industrial Applications of Lasers, Academic Press, 2012.
3. Gerd Keiser, Optical Fiber Communication, Mc Graw Hill, New York, 2013.
4. S.C. Gupta, Textbook on Fiber Optics Communications and its application, Prentice Hall of India, 2012.
5. John Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2011.
6. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2011.

22OBT01 BIOFUELS 3 0 0 3

Course Objectives

- To understand and explore the scope of biofuels the most efficient renewable source of energy.
- To develop the expertise in the technology pertaining to their generation and employment in order to surrogate the existing conventional fuels and hence strives towards sustainable development
- To give way to the bolster green technology and incline towards more ecofriendly options.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PSO3. Execute professional capabilities to competitively work in industries with global Standards by implementing recent tools and techniques.

Course Outcomes (COs)

1. Apply thee bio resources that can be used for the production of biofuels.
2. Analyze the physical and chemical properties of the biodiesel.
3. Analyze the mechanisms of improvising the quality and performance of engines using biofuels
4. Analyze the bio-fuel conversion technologies and their environmental attributes
5. Evaluate the designing aspects of major unit processes/operations of an integrated bio- refinery

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	2	-	-	-	3	-	-	-	-	-	-	-	1
2	2	1	-	3	-	-	1	-	-	-	-	-	-	-	3
3	1	2	-	2	-	2	3	-	-	-	-	-	-	-	2
4	2	3	-	-	-	2	3	-	-	-	-	-	-	-	3
5	1	2	3	3	-	-	1	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

CLASSIFICATION AND RESOURCES

Introduction, biofuel as a renewable energy, classification of biofuels - First, second, third and fourth generation biofuels, different plant sources as biofuel feed stocks, Biogases, physical and chemical characteristics of vegetable oils - iodine number, hydroxyl, acid values, rancidity, hydrogenolysis and hydrolysis, Food vs energy.

UNIT II **9 Hours**

BIODIESEL

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Trans esterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number.

UNIT III **9 Hours**

QUALITY BIODIESEL AND ENVIRONMENT

Producing Quality Biodiesel, quality control, test methods, ASTM specifications. Oxidative and thermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high speed diesel (HSD) and their combustion properties.

UNIT IV **9 Hours**

BIOETHANOL AND BIOGASES

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass - lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling processes, saccharification-chemical and enzymatic. Production of bio methane and bio hydrogen.

UNIT V **9 Hours**

BIOREFINERIES

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purification of glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

Total: 45 Hours

Reference(s)

1. Caye Drapcho, John Nghiem and Terry Walker, Biofuels Engineering process technology, McGraw Hill Professional, 2008.
2. Mousdale, Biofuels, CRC Press, 2008
3. Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill Professional, 2007.
4. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology), Springer, 2007

22OFD01 TRADITIONAL FOODS 3 0 0 3

Course Objectives

- Understand the importance of traditional foods and food habits
- Know the traditional processing of snack, sweet and dairy food products
- Infer the wide diversity and common features of traditional Indian foods and meal patterns.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Justify the processing methods of traditional foods in terms of its health benefits
2. Assess the production methods of traditional sweets, snacks and dairy products
3. Differentiate Traditional fermented foods products based on its raw material
4. Implement a large scale production of tradition foods for its increased consumption
5. Compare the health aspects of traditional foods with modern foods

Articulation Matrix

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

UNIT I **9 Hours**

TRADITIONAL METHODS OF FOOD PROCESSING

Introduction - food culture -geographical features and food. Traditional methods of milling grains - rice, wheat and corn - equipment and processes as compared to modern methods. Equipment and processes for edible oil extraction- comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation - sun-drying, osmotic drying, brining, pickling and smoking.

UNIT II **9 Hours**

TRADITIONAL SWEETS, SNACKS AND DAIRY PRODUCTS

Production, formulation, preparation and processing of Indian traditional sweet and snack food products:-Rasgolla, Gulab jamun; formulation and preparation of namkeen, potato chips, banana chips. Acid coagulated and fermented dairy products- paneer, dahi, shrikhand, lassi - processing conditions, defects etc. Fat rich products- Butter, ghee and its processing.

UNIT III **9 Hours**

TRADITIONAL FERMENTED FOOD PRODUCTS

Idli, Soya sauce, fish pickle, dry fish, meat and vegetable fermented products. Various alcohol based products. Ways to increase nutritional quality of food such as enrichment, fortification, fermentation and mutual supplementation. Best cooking and processing methods to retain nutrients

UNIT IV **10 Hours**

COMMERCIAL PRODUCTION OF TRADITIONAL FOODS

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods -types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods - ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters

UNIT V **8 Hours**

HEALTH ASPECTS OF TRADIONAL FOODS

Comparison of traditional foods with typical fast foods / junk foods - cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

Total: 45 Hours

Reference(s)

1. Sen and Colleen Taylor, Food Culture in India, Greenwood Press, 2005.
2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes:" East West Books, 2001.
3. Steinkrus.K.H. Handbook of Indigenous Fermented Foods, CRC press, 1995.
4. Aneja. R.P, Mathur.BN, R.C. Chandan,and Banerjee.A.K. Technology of Indian Milk Products. Dairy India Year Book, 2009.

22OFT01 FASHION CRAFTSMANSHIP 3 0 0 3

Course Objectives

- To impart theoretical and practical knowledge about various handi-craft techniques
- To enhance innovative skills on hand crafts.
- To build confidence on doing handicrafts.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. 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.

PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1. Implement new ideas on product / process development by utilizing the knowledge of design and manufacturing.

Course Outcomes (COs)

1. Outline the classification, techniques and criteria for selecting raw materials for making various handicraft materials and produce textile based handicrafts. Produce various decorative and appealing products
2. Design and construct various wall hangings and fashion accessories.
3. Design and construct toys and accessories
4. Design and construct head accessories, home furnishings and paintings
5. Design and construct various decorative and appealing products for interiors

Articulation Matrix

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

UNIT I **9 Hours**

TECHNIQUES OF HANDICRAFT MATERIALS

Definition of Handicraft, Classification: Reusable, Non reusable, Raw materials used in various craft materials: printed, embroidered, stitched and handmade, Criteria for selection of raw materials: material types and end uses.

UNIT II **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - INTERIORS

Designing and Construction procedures for following various decorative and appealing products: Wall hangings - String Art on plywood, Pressed Flower Art frames.

UNIT III **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - ACCESSORIES

Designing and Construction procedures for following various decorative and appealing products: Handbags, Hats, footwear.

UNIT IV **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - ORNAMENTS

Designing and Construction procedures for following various decorative and appealing products: Stone necklace using Macrame Technique, Tribal Jewellery using woollen threads, Floral Jewellery using Resin Technique, Fabric Jewellery using Tie and Dye Technique.

UNIT V **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - FANCY ITEMS

Designing and Construction procedures for following various decorative and appealing products: Jewellery Box, Utility Holder, Gift items. Lampshade decors from cardboard, Driftwood Frames for pictures and Mirrors.

Total: 45 Hours

Reference(s)

1. Handmade in India: A Geographic Encyclopaedia of India Handicrafts. Abbeville press; 1 edition (October 20,2009)
2. Encyclopaedia of Card making Techniques (Crafts), Search Press Ltd, illustrated edition, 2007
3. All about Techniques in Illustration, Barron Educational Series, 2001
4. Printing by Hand: A Modern Guide to printing with Handmade stamps, Stencils and Silk Screens, STC Craft/A Melanie Falick Book, 2008
5. Materials & Techniques in the Decorative Arts: An Illustrated Dictionary, University of Chicago Press, 2000
6. https://www.marthastewart.com/274411/fashion-crafts

22OFT02 INTERIOR DESIGN IN FASHION 3 0 0 3

Course Objectives

- To impart knowledge on interior design.
- To improve the design skills, sustainable with socially-conscious designs

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PSO1. Implement new ideas on product / process development by utilizing the knowledge of design and manufacturing.

Course Outcomes (COs)

1. Interpret the elements of interior design concepts and resolve the personality requirements
2. Develop graphical representations of interior design concepts
3. Resolve the space planning requirements of residential home as per CPWD guidelines
4. Determine the aesthetic requirements of interior design components.
5. Appraise the roles and responsibilities of interior designer.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Interior designing - definition, importance, requirements and types - Structural design, Decorative Design -Designing interiors, Good taste; Design themes, types and application. Personality of the Home - Art elements - Line: types, characteristics and importance; form: size and shape, characteristics; Colour - sources, qualities, emotional effects, colour wheel and schemes.

UNIT II **9 Hours**

GRAPHICAL PRESENTATIONS

3D composition; Isometric and Axonometric- Still life- Furniture Sketching- Object Drawing with color rendering - Interior elements, Lighting, plants. Perspective, Axonometric Isometric drawing. Orthographic Projection - Lifts and escalators.

UNIT III **9 Hours**

SPACE PLANNING

Space planning concepts- interiors, circulation. Definition, application of ergonomic principals in interiors. Residential house space planning case study- CPWD guidelines. Lighting for different locations and activities, measurement, ventilation and indoor air quality, noise control methods.

UNIT IV **9 Hours**

INTERIOR COMPONENTS

Application of colour in interiors; Texture - types and significance; Pattern: types and effects; Light - importance. Importance of Furniture Design for Interiors- Ancient Age / Middle Age / Contemporary. Doors, Windows, Staircase designs, False Ceiling, Partitions, Wall Panelling, Comics, Mosaic, Cladding- Flooring and Wall Cladding

UNIT V **9 Hours**

ROLES AND RESPONSIBILITIES OF INTERIOR DESIGNER

Role of an Interior Designer- Responsibility towards society and need of an Interior Designer to better the environment- Ethics and Code of Conduct- Responsibility towards client, contractor and supplier, Estimation. Professional Fees- Work of an Interior Designer- Making of portfolio, JD Annual Design Awards.

Total: 45 Hours

Reference(s)

1. Joanna Gaines, Homebody: A guide to creating spaces you never want to leave, Harper design, 2018.
2. Erin gates, Elements of Style: Designing a Home and a life, Simon and Schuster, 2014.
3. Simon Dodsworth, The Fundamentals of Interior Design, AVA publishing, 2009.
4. V. Mary. Knackstedt, The Interior Design Business Handbook: A Complete Guide to Profitability, Wiley, New Jersey; 2006.
5. M. G. Shah, C. M. Kale, and S.Y. Patki, Building Drawing with an Integrated Approach to Build Environment, Tata McGraw Hill, 2002.
6. Https://eclectictrends.com

22OFT03 SURFACE ORNAMENTATION 3 0 0 3

Course Objectives

- To familiarize the students about the various techniques of surface embellishment with relevance to garment embellishments.
- To aware of various types of embroidery and methods of producing it.
- To make the students confident about doing surface embellishment work

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PSO1. Implement new ideas on product / process development by utilizing the knowledge of design and manufacturing.
PSO2. Apply knowledge acquired in mechanical engineering with an analytical / computational tools to design, analyze and provide solutions for fluid flow and thermal related applications.

Course Outcomes (COs)

1. Analyze the raw material requirements for surface ornamentation and its application
2. Implement hand embroidery stitches on fabric and show the stitch development procedure in diagrammatic representations
3. Apply the machine and computerized embroidery stitches
4. Analyze the surface embellishment techniques and its application
5. Assess the quality maintenance parameters of all embroidered products and analyze the 6 traditional embroidery techniques

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO SURFACE ORNAMENTATION

Introduction, Definition, Need, Types, Raw materials, Importance of surface ornamentation, Selection of needle, thread and fabric for hand embroidery and machine embroidery. various methods of surface embellishment- embroidery and surface ornamentation.

UNIT II **9 Hours**

HAND EMBROIDERY

General rules for hand embroidery. Types of hand embroidery stitches-Running, Couching, Button hole, Satin, Long & Short, Wheat, Chain, Stem, Herringbone, Cross stitch, Knotted stitches, Fish bone, Fly stitch, Braids, Back, Hem, Seed, Needle weaving, Whip stitches.

UNIT III **9 Hours**

MACHINE EMBROIDERY

General rules for machine embroidery. Types of frames and methods of transferring the designs. Attachments to sewing machines for embroidery, Types of machine embroidery stitches- Eyelet work, Cut work, patch work, Mirror work, Applique, Shaded embroidery, Shadow work, Bead and Sequins work, Vermicelli, Zigzag, Granite stitch. Computerized embroidery machine- Concept of design and development, software used in embroidery machines, process of designing, method and types of stitch application, punching and digitizing.

UNIT IV **9 Hours**

EMBELLISHMENT TECHNIQUES

Materials used and Applications. Types of embellishment techniques- fabric painting-hand, Stencil-dabbing and Spraying. Dyeing and printing-advanced tie and dye techniques, batik and block printing. Trimmings and decorations-Laces, Pompons, Fringes, Tassels, Tucks, Show buttons, Crocheting.

UNIT V **9 Hours**

TRADITIONAL EMBROIDERIES OF INDIA AND CARE

Care and maintenance of embroidered articles-care and maintenance methods for embroidered apparel, pressing. Traditional Embroideries of India-Phulkari, Kasuti, Kashmiri embroidery, Kutch work, Chikkankari, Kantha.

Total: 45 Hours

Reference(s)

1. Ruth Chandler, Modern Hand Stitching-Dozens of stitches with creative free-form variations,2014
2. Sophie Long, Mastering the Art of Embroidery: Traditional Techniques and Contemporary Applications for Hand and Machine Embroidery, Heritage Publishers, London, 2013
3. Christen Brown ,Embroidered & Embellished, C&T Publishing, 2013
4. Sheila Paine, Embroidered Textiles, Thames and Hudson Publisher, UK, 1990.
5. Gail Lawther, Inspirational Ideas for Embroidery on Clothes & Accessories, Search Press Ltd, UK, 1993.
6. http://www.needlenthread.com/tag/hand-embroidery-stitches

22OPH01 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I **9 Hours**

NANO SCALE MATERIALS

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

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

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

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

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

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

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

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- single electron transistor - - organic photovoltaic cells- spintronics

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, AuliceScibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

22OPH02 SEMICONDUCTOR PHYSICS AND DEVICES 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

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

Articulation Matrix

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

UNIT I 9 Hours

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

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

UNIT II 9 Hours

P-N JUNCTION

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

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

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

UNIT IV **9 Hours**

MOSFET

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

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

22OPH03 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

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

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein's prediction - Einstein's relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement - holography

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting - Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006

22OPH04 BIOPHOTONICS 3 0 0 3

Course Objective:

- To understand the light-matter interaction in biological cells or tissues by using the principles of optics and lasers.
- To apply the properties of biological cells or tissues in biomedical applications by various optical imaging, sensing and activation techniques.
- To analyze the concepts of Modern optical measurement techniques and devices in early detection of disease and cure them.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO4. 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.

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Infer the laws of optics and lasers to interpret the biological cells and tissues.
2. Identify the properties of different optical instruments in biological systems to represent their behavior in structure and design of detection engineering instruments.
3. Use laser tweezers techniques to infer the activities of cells (tissues) and explain the single molecule detection processes in medical diagnosis.
4. Outline the properties of ultra short laser pulses and tissue engineering to rectify the affecting factors in biological cells.
5. Compare the various types of bio-imaging methods to detect the infected cells and molecules in biological science.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO BIOPHOTONICS

Light as Photon Particles – Coherence of light - lasers – classification of lasers – Mechanisms of Non-linear Optics (NLO) processes associated with Biophotonics - Light scattering mechanisms: Rayleigh scattering, Miescattering, Brillouin Scattering, Raman Scattering -Different light sources – Quantitative description of light: Radiometry

UNIT II **9 Hours**

PHOTOBIOLOGY

Interaction of light with cells and tissues – Light – Tissue Interaction Variables – Light –Tissue Interaction Theory: Radiative Transport Theory – Photo process in biopolymers – In Vivo Photoexcitation – photo-induced physical, chemical, thermal and mechanical effects in biological systems – Optical biopsy – Single molecule detection

UNIT III **9 Hours**

BIONANO PHOTONICS

Laser Microtools, Semiconductor quantum dots for bioimaging, Metallic nanoparticles and nanorods for biosensing – Optical biosensors: Fibre-Optic, evanescent wave, surface Plasmon resonance (SPR) based biosensors – biomaterials for photonics – Principle and design of laser tweezers – laser trapping and dissection for biological manipulation.

UNIT IV **9 Hours**

TISSUE ENGINEERING WITH LIGHT

Basics of tissue optics: Light absorption and scattering in tissues, Wavelength effects and spectra– the therapeutic window, Light penetration in tissues – Absorbing agents in tissues and blood –Skinoptics, response to the UV radiation, Optical parameters of tissues – tissue welding – tissue contouring – tissue regeneration – Femto laser surgery – low level light therapy and photo dynamic therapy

UNIT V **9 Hours**

BIO-IMAGING TECHNIQUES AND ITS APPLICATIONS

An overview of optical imaging – Fluorescence Microscopy – Scanning Microscopy – In vivo Confocal Microscopy – Multi photon Microscopy – Optical Coherence Tomography (OCT) – Fluorescence Resonance Energy Transfer (FRET) imaging – fluorescence lifetime imaging Microscopy (FLIM) – Nonlinear optical imaging – Coherent Anti-stokes Raman Scattering –Bioimaging Applications.

Total: 45 Hours

Reference(s)

1. Introduction to Biophotonics, ParasN.Prasad, WileyInter-science, AJohnWiley & Sons, Inc., Publication (Class notes are developed mainly based on this book.)
2. Introduction to Biomedical Imaging, Andrew G.Webb, 2002, IEEE Press.
3. Biomedical Optics: Principles and Imaging, Lihong.V.Wang, Hsin.-I.Wu, 2007, Wiley Interscience 2007. & "An Introduction to Biomedical Optics", R.Splinterand B.A.Hooper, Taylor & Francis
4. Bioimaging Current Concepts in Light and Electron Microscopy, DouglasE.Chandler & Robert W.Roberson, Jones and Bartlett publishers.
5. Optical Imaging and Microscopy : Techniques and Advanced Systems, Peter Török and Fu-JenKao, 2004, Springer.

22OPH05 PHYSICS OF SOFT MATTER 3 0 0 3

Course Objectives

- To recognize the properties of soft matter and hard matter
- To understand the fundamental interactions of colloids and gels
- To explain the structure and phase behavior of liquid crystals and supramolecules
- To summarize the soft matter proprties of structures and components of life

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Identify the salient features of soft matter and hard matter
2. Exemplify the fundamental interactions and stability of colloids and gels
3. Illustrate the structure and properties of liquid crystals
4. Outline the aggregation and phase behavior of surfactants, polymers, copolymers and block copolymers
5. Analyze the soft matter behavior of nucleic acids, proteins, polysaccharides and membranes

Articulation Matrix

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

UNIT I 9 Hours

CONDENSED MATTER

Intermolecular forces-Condensation and freezing-mechanical response: Hookean solid-Newtonian liquid-viscoelasticity. Glasses: relaxation time-viscosity- glass forming liquids. Soft matter: length scales-fluctuations and Brownian motion

UNIT II 9 Hours

COLLOIDAL DISPERSIONS & GELS

Forces between colloidal particles: vander Waals forces-electrostatic double layer forces-steric hindrance-depletion interactions. Stability and phase behaviour: Crystallisation-strong colloids-weak colloids.Physical and chemical gels-classical theory of gelation-elasticity of gels

UNIT III **9 Hours**

LIQUID CRYSTALS

Liquid crystal phases-distortions and topological defects-electrical and magnetic properties-polymer liquid crystals-Fredricks transition and liquid crystal displays

9 Hours

UNIT IV

SUPRAMOLECULAR SELF ASSEMBLY

Aggragation and phase separation-types of micelles- bilayers and vesicles. Phase behaviour of concentrated surfactant solutions-phase separation in polymers, copolymers and block copolymers

9 Hours

UNIT V

SOFT MATTER IN NATURE

Components and structures of life-Nucleic acids-proteins-interaction between proteins-polysaccharides-membranes

Total: 45 Hours

REFERENCES

1. Richard A L Jones, Soft Condensd Matter, Oxford University Press, UK, 2002
2. Masao Doi, Soft Matter Physics,Oxford University Press, UK, 2013.
3. Ian W. Hamley, Introduction to Soft Matter, John Wiley & Sons, 2007
4. A. Fernandez-Nieves, A M Puertas, Fluids, Colloids and Soft materials: An Introduction to Soft Matter Physics, John Wiley & Sons, 2016
5. Maurice Kleman, Oleg D. Lavrentovich, Soft Matter Physics: An Introduction, Springer-Verlag, New York, 2003.

22OCH01 CORROSION SCIENCE AND ENGINEERING

3 0 0 3

Course Objectives

- Analyse the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

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

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing - Ultrasonic monitoring, and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.html

22OCH02 POLYMER SCIENCE 3 0 0 3

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers
- Identify suitable polymers for various industrial applications

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Identify the structure, thermal, and mechanical properties of polymers for different applications
4. Apply the polymer processing methods to design polymer products
5. Analyze the polymers used in electronic and biomedical applications.

Articulation Matrix

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

UNIT I 10 Hours

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) -ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II 8 Hours

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers – E waste management. Polymer for biomedical applications: artificial organs, controlled drug delivery, Scaffolds in tissue Engineering –waste management.

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2021
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2008
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011
7. Common Biocompatible Polymeric Materials for Tissue Engineering and Regenerative Medicine (2019), Materials Chemistry and Physics https://doi.org/10.1016/j.

22OCH03 ENERGY STORING DEVICES 3 0 0 3

Course Objectives

- Compare the energy density of commercialized primary and secondary batteries.
- Classify the fuel cells and compare their efficiency in different environmental conditions.
- Demonstrate the various energy storage devices and fuel cells.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Find the parameters required for operation of a cell to evaluate the capacity of energy storage devices.
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications.
3. Differentiate fuel cells based on its construction, production of current and applications.
4. Compare different methods of storing hydrogen fuel and its environmental applications.
5. Classify the solar cell based on the materials used in it.

Articulation Matrix

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

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage - open circuit voltage current density - cycle life - discharge rate-over charge-over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries: zinc-carbon - magnesium,and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries: lead acid - nickel-cadmium - lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide - lithium anode cell - photogalvanic cells. Battery specifications for cars and automobiles. Extraction of metals from battery materials.

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells: Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells - phosphoric acid - solid oxide - molten carbonate and direct methanol fuel cells

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen: Electrolysis and photocatalytic water splitting. Methods of hydrogen storage: High pressurized gas - liquid hydrogen type - metal hydride. Hydrogen as engine fuel - features, application of hydrogen technologies in the future – limitations.

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell.

Total: 45 Hours

Reference(s)

1. N. Eliaz, E. Gileadi, Physical Electrochemistry, Fundamentals, Techniques and Applications, Wiley, 2019.
2. J. Garche, K. Brandt, Electrochemical Power sources: Fundamentals Systems and Applications, Elsevier, 2018
3. S.P. Jiang, Q. Li, Introduction to Fuel Cells, Springer, 2021.
4. A. Iulianelli, A. Basile, Advances in Hydrogen Production, Storage and Distribution, Elsevier, 2016.
5. M.M. Eboch, The Future of Energy, From Solar Cells to Flying Wind Farms, Capstone, 2020.

22OMA01 GRAPH THEORY AND COMBINATORICS

3 0 0 3

Course Objectives

- This course comprehends the graphs as a modeling and analysis tool in computer science & Engineering
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory based computing and network security studies in Computer Science.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Recognize the basic ideas of Graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Predict the coloring of graphs and its applications in the respective areas of engineering.
4. Compute the permutations and combinations in the engineering field.
5. Demonstrate the types of generating functions and their applications in engineering.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

UNIT II **9 Hours**

TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

UNIT IV **9 Hours**

PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

UNIT V **9 Hours**

GENERATING FUNCTIONS

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - Non-homogeneous recurrence relations - Method of generating functions.

Total: 45 Hours

Reference(s)

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics And Its Applications, McGraw Hil, 2007
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

22OGE01 PRINCIPLES OF MANAGEMENT 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO11. 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.

Course Outcomes (COs)

1. Students will be able to understand the basic concepts of Management.
2. Have some basic knowledge on planning process and its Tools & Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	-	-	-	2	-	3	-	-	-	-
2	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-
3	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-
4	-	-	-	-	-	-	-	-	3	-	2	-	-	-	-
5	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-

UNIT I **9 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

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

UNIT II **9 Hours**

PLANNING

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

UNIT III **9 Hours**

ORGANISING

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

UNIT IV **9 Hours**

DIRECTING

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

UNIT V **9 Hours**

CONTROLLING

System and process of controlling - Budgetary and non-Budgetary control techniques - Use of Computers and IT in Management control - Productivity problems and management - Control and Performance-Direct and preventive control - Reporting.

Total: 45 Hours

Reference(s)

1. Robbins S, Management, (13th ed.), Pearson Education, New Delhi, 2017.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education, 7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007.
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008.

22OGE02 ENTREPRENEURSHIP DEVELOPMENT I 3 0 0 3

Course Objectives

- Learn the basics and scope of the Entrepreneurship
- Understand the generation of ideas of the Entrepreneurship
- Evolve the legal aspects of the business
- Learn to analyze the various business finance
- Learn the basics of the Operations Management

Programme Outcomes (POs)

PO6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Analyze the role of entrepreneurship in economic development.
2. Explain the types of ideas that to be used for entrepreneurship development.
3. Examine the legal aspects of business and its association.
4. Examine the sources of business and its analysis.
5. Analyse the different modes of operation management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
2	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
3	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
4	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
5	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance – functions - deciding on the production system - facility decisions: plant location, plant layout (cases), capacity requirement planning - inventory management (cases) - lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006

22OGE03 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promotion the product / services
- Handle the human resources and taxation
- Learn to analyze the taxation
- Understand the Government industrial policies and supports
- Preparation of a business plan

Programme Outcomes (POs)

PO6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Examine the strategies and plans in marketing management.
2. Analyse the cases involved in human resource management.
3. Classify the direct and indirect taxes in business.
4. Analyze the supports given by government for improving the business.
5. Examine the various steps involved in preparing the business plan.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
2	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
3	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
4	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-
5	-	-	-	-	-	1	2	-	2	-	-	-	-	-	-

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment, Segmentation, Targeting and positioning, Formulating marketing strategies, Marketing research, marketing plan, marketing mix (cases)

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view)

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases). Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute - NIESBUD, IIE, EDI. State Level Institutions - TIIC, CED, MSME, Financial Institutions

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.html

22OGE04 NATION BUILDING, LEADERSHIP AND SOCIAL RESPONSIBILITY

3 0 0 3

Course Objectives

- To understand the importance of National Integration, Patriotism and Communal Harmony
- To outline the basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality
- To analyze the different types of responsibility role of play for the improvement of society

Programme Outcomes (POs)

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3: 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.
PO7: 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.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand religo-cultural diversity of the country and its impact on the lives of the people and their beliefs
2. Acquire a sense of responsibility, smartness in appearance and improve self confidence
3. Develop the sense of self-less social service for better social & community life
4. Apply the importance of Physical and Mental health and structure of communication organization and various mode of communication
5. Acquire awareness about the various types of weapon systems in the Armed Forces.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
1	2	-	1	-	-	-	1	-	-	-	-	3	-	-	-
2	2	-	2	-	-	-	2	-	-	-	-	2	-	-	-
3	2	-	1	-	-	-	1	-	-	-	-	2	-	-	-
4	2	-	3	-	-	-	3	-	-	-	-	3	-	-	-
5	2	-	1	-	-	-	1	-	-	-	-	2	-	-	-

UNIT I **9 Hours**

NATIONAL INTEGRATION

Importance & Necessity, Factors Affecting National Integration, Unity in Diversity. Threats to National Security. Water Conservation and Rain Harvesting, Waste Management and Energy Conservation. Leadership Capsule-Traits-Indicators-Motivation-Moral Values-Honor Code-Case Studies: Shivaji, Jhansiki Rani, Case Studies–APJ Abdul kalam, Deepa Malik, Maharana Pratap, N Narayan Murthy Ratan Tata Rabindra Nath Tagore, role of NCC cadets in 1965 war.

UNIT II **9 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

Intra & Interpersonal skills - Self-Awareness- &Analysis, Empathy, Critical & creative thinking, Decision making and problem solving, Communication skills, Group Discussion – copping with stress and emotions, changing mindset, Public Speaking, Time Management, Social skills, Career counseling, SSB procedure and Interview skills.

UNIT III **9 Hours**

SOCIAL SERVICE, COMMUNITY DEVELOPMENT AND ENVIRONMENTAL AWARENESS

Basics of social service and its need, Types of social service activities, Objectives of rural development programs and its importance, NGO's and their contribution in social welfare, contribution of youth and NCC in Social welfare. Protection of children & women safety, Road/ Rail Travel Safety, New initiatives, Cyber and mobile security awareness.

Disaster management Capsule-Organization-Types of Disasters-Essential Services-Assistance-Civil Defence Organization

UNIT IV **9 Hours**

HEALTH, HYGIENE AND COMMUNICATION

Sanitation, First Aid in Common Medical Emergencies. Health, Treatment and Care of Wounds. Yoga-Introduction, Definition, Purpose, Benefits. Asanas-Padamsana, Siddhasana, Gyan Mudra, Surya Namaskar, Shavasana, Vajrasana, Dhanurasana, Chakrasana, Sarvaangasana, Halasanaetc.

Obstacle Training Contact: Obstacle training - Intro, Safety measures, Benefits, Straight balance, Clear Jump, Gate Vault, ZigZagBalance, High Wall etc.

COMMUNICATION: Basic Radio Telephony (RT) Procedure-Introduction, Advantages, Disadvantages, Need for standard- Procedures-Types of Radio Telephony Communication-Radio telephony procedure, Documentation.

UNIT V **9 Hours**

ARMED FORCES AND NCC GENERAL

Army, navy, Air force and Central armed policed forces- Modes of entry into army, police and CAPF-Naval expeditions & campaigns. History, Geography of Border / Coastal areas. EEZ maritime security & ICG. Modes of Entries in armed forces. Security challenges & role of cadets in Border management. Aims, Objectives and org of NCC- Incentives- Duties of NCC cadets- NCC Camps: types and conduct.

Total: 45 Hours

Reference(s)

1. Director General NCC Website: https://indiancc.nic.in/ncc-general-elective-subject-course-design/
2. Grooming Tomorrow's Leaders, published by DG, NCC. https://indiancc.nic.in/
3. Youth in Action, published by DG, NCC. https://indiancc.nic.in/
4. The Cadet, Annual Journal of the NCC. https://indiancc.nic.in/
5. Précis Issued by respective Service Headquarters on specialized subject available to PI Staff as reference material. https://indiancc.nic.in/

22OME01 DIGITAL MANUFACTURING 3 0 0 3

Course Objectives

- To understand the process of generating 3D Computer Aided Design (CAD) model by different method.
- To explain the constructional features and develop simple program for CNC lathe and Milling machines.
- To provide an exhaustive knowledge on various generic process and benefits of Additive Manufacturing.
- To familiarize about materials and process parameters of liquid and solid based AM techniques.
- To educate powder based methodology and emerging trends with case studies, applications of AM techniques.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO4. 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.
PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
PSO1. Implement new ideas on product / process development by utilizing the knowledge of design and manufacturing.
PSO2. Apply knowledge acquired in mechanical engineering with an analytical / computational tools to design, analyze and provide solutions for fluid flow and thermal related applications.

Course Outcomes (COs)

1. Design a 3D model from the 2D data.
2. Develop a CNC program for simple components.
3. Generate stl file and manipulate parameters of AM machine
4. Select appropriate liquid or solid materials based AM process to the respective application
5. Select appropriate process to fabricate a functional/prototype for aerospace, automotive, electronics, manufacturing and medical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	2	2	-	-	-	-	-	-	-	1	2	-
2	2	2	2	2	2	-	-	-	-	-	-	-	1	2	-
3	2	2	2	2	2	-	-	-	-	-	-	-	1	2	-
4	2	2	2	2	2	-	-	-	-	-	-	-	1	2	-
5	2	2	2	2	2	-	-	-	-	-	-	-	1	2	-

UNIT I **9 Hours**

CAD MODELING

Introduction - Design process - Stages. CAD - Input and Output devices, Modeling methods - Wire frame modelling, Surface modelling, Solid modelling - Constructive Solid Geometry and Boundary Representation Techniques. CAD/CAM data exchange - IGES, STEP. Product Life cycle management (PLM).

UNIT II **10 Hours**

AUTOMATION AND CNC MACHINES

Introduction to Automation - Definition, types, reasons for automating. CNC Machines - Principles, types, features, advantages, applications. CNC Machine structure - Linear motion bearings, Recirculating ball bearings, drive system, and control system. CNC Lathe and Milling programming - Linear and circular interpolation, threading and drilling programs.

UNIT III **7 Hours**

ADDITIVE MANUFACTURING

Introduction - Impact of Additive Manufacturing (AM) and Tooling on Product Development - Distinction between AM and CNC Machining - The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - AM Benefits - Classification of AM process

UNIT IV **8 Hours**

LIQUID AND SOLID MATERIAL BASED SYSTEMS

Stereo lithography Apparatus (SLA), Digital Light Processing (DLP), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Process, Materials and Applications

UNIT V **11 Hours**

POWDER BASED PROCESSES AND APPLICATIONS OF ADDITIVE MANUFACTURING

Selective Laser Sintering (SLS), Color Jet Printing (CJP), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS) - Working Principle, Construction, Process Variables, Materials and Applications. Reverse Engineering using 3D scanner. Application of Additive Manufacturing in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries.

Total: 45 Hours

Reference(s)

1. Ibrahim Zeid, R.Sivasubramania, CAD/CAM Theory and Practice, Tata McGraw Hill, 2010.
2. M. Aditan, B.S. Pabala, CNC Machines, New age International, 2012.
3. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
4. D. T.Pham, S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
5. I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Technologies 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Springer, 2015 http://www.springer.com/978-1-4939-2112-6
6. www.grabcad.com, www.all3dp.com

22OME02 INDUSTRIAL PROCESS ENGINEERING 3 0 0 3

Course Objectives

- To impart the knowledge on production planning methodologies and layout design
- To learn about production planning and its control methods
- To provide the knowledge of work study, process charts and ergonomic condition
- To impart the knowledge on inventory control and material handling
- To learn about system analysis and different types of maintenance processes

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

PO11. 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.

PSO2. Apply knowledge acquired in mechanical engineering with an analytical / computational tools to design, analyze and provide solutions for fluid flow and thermal related applications.

Course Outcomes (COs)

1. Select proper plant layout for the required production system
2. Plan the resources required for the production and to perform the control methods
3. Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes.
4. Analyze the inventory required based on production needs and material handling
5. Perform system analysis and use different types of maintenance process for smooth operations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	1	-	1	-	-	-	-	-	-	-	-	2	-
2	3	3	1	-	2	-	-	-	-	-	2	-	-	2	-
3	1	3	3	-	2	-	-	-	-	-	-	-	-	2	-
4	2	3	1	-	2	-	-	-	-	-	-	-	-	2	-
5	2	3	1	-	2	-	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

INDUSTRIAL ENGINEERING AND PRODUCTION SYSTEM

Industrial engineering - Concept, History and development, Applications, Roles of Industrial engineer-Production management, Industrial engineering versus production management, operations management. Plant layout, Criteria for good layout, Types of layout - Process layout, Product layout, Combination layout and fixed position layout, Flow (material movement) pattern, Workstation Selection and design.

UNIT II **10 Hours**

PROCESS PLANNING AND PRODUCTION CONTROL

Introduction to Process planning-Definition, Procedure, Process selection, Machine capacity, Process sheet.Process analysis - Group technology, classification and coding system, formation of component family - Production planning, loading, scheduling. Production control -dispatching, routing - Progress control bar, curve, Gantt chart, route and schedule chart.

UNIT III **8 Hours**

WORK STUDY AND ERGONOMICS

Work study - Definition, Need, Advantages, objectives of method study and work measurement, method study procedure, Process chart - symbols, outline process chart, flow process chart, principles of motion economy, ergonomics- applications of ergonomic principles in the shop floor- work benches-seating arrangement, Industrial physiology.

UNIT IV **10 Hours**

INVENTORY MANAGEMENT

Inventory control, classification, management, objectives, functions. Economic order quantity, Economic batch quantity, inventory models,ABC analysis, Material Requirement Planning(MRPI), Manufacturing Resource Planning (MRPII), Operating cycle, lean manufacturing, Supply chain management - Material handling.

UNIT V **8 Hours**

SYSTEM ANALYSIS AND MAINTENANCE

System concept - system analysis, systems engineering, value engineering, value control, types of values. Plant maintenance - objectives, importance. Maintenance engineer - duties, functions and responsibilities. Types - breakdown, scheduled, preventive and predictive - Plant maintenance schedule, Condition monitoring.

Total: 45 Hours

Reference(s)

1. Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications.,2010
2. Martand T.Telsang, Industrial Engineering and Production Management, S Chand Publishers,2006
3. Panneerselvam R., Production and operations management, Heritage Publishers, 2006
4. Ravi Shankar, Industrial Engineering and Management, Golgotia Publications Pvt. Ltd., New Delhi, 2009

22OME03 MAINTENANCE ENGINEERING 3 0 0 3

Course Objectives

- To understand the principles, objectives and importance of maintenance adopted in industry for successful progress.
- To introduce different maintenance categories, its merits and types of lubrication.
- To expose the idea of condition monitoring, methods and instruments used for allied measurements.
- To learn about failure analysis and repair methods for few mechanical elements.
- To promote computerization in maintenance and inventory management.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. 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.
PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PSO2. Apply knowledge acquired in mechanical engineering with an analytical / computational tools to design, analyze and provide solutions for fluid flow and thermal related applications.

Course Outcomes (COs)

1. Explain the principles, objectives and importance of maintenance adopted in industry.
2. Select the suitable maintenance category and lubrication type.
3. Apply the appropriate methods and instruments for condition monitoring.
4. Analyze the failures of mechanical systems and select suitable repair methods.
5. Utilize computers in maintenance and inventory management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	-	-	-	-	-	-	-	-	-	-	-	2	-
2	2	2	-	-	-	-	-	-	-	-	-	-	-	2	-
3	-	-	-	-	2	2	1	-	-	-	-	-	-	2	-
4	1	2	1	-	2	2	2	-	-	-	-	-	-	2	-
5	2	2	2	-	1	1	1	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

PRINCIPLES OF MAINTENANCE PLANNING

Basic principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.

UNIT II **9 Hours**

MAINTENANCE CATEGORIES AND LUBRICATION

Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.

UNIT III **9 Hours**

CONDITION MONITORING

Condition based maintenance - Cost comparison with and without Condition Monitoring - Methods and instruments for condition monitoring - Noise, vibration, wear and temperature measurement.

UNIT IV **9 Hours**

FAILURE ANALYSIS AND REPAIR METHODS

Failure analysis - Failures and their development - Role of Non Destructive Testing in failure analysis - Repair methods for bearings, cylinder block, fuel pump, shaft.

UNIT V **9 Hours**

COMPUTER AIDED MAINTENANCE MANAGEMENT

Approach towards Computerization in maintenance - computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.

Total: 45 Hours

Reference(s)

1. Srivastava S.K, Maintenance Engineering, S Chand and Company, 2010.
2. Mishra R.C, Pathak K, Maintenance Engineering and Management, Second edition, Prentice Hall India Learning Pvt. Ltd., 2012.
3. Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, Maintenance Engineering Handbook, Seventh edition, McGraw-Hill Professional, 2008.
4. Davies A, Handbook of Condition Monitoring: Techniques and Methodology, Springer, 2012.
5. Otegui Jose Luis, Failure Analysis, Fundamentals and Applications in Mechanical Components, Nineteenth edition, Springer, 2014.

22OME04 SAFETY ENGINEERING 3 0 0 3

Course Objectives

- To study the principles of safety management system.
- To introduce the provisions contained in the industrial laws.
- To provide knowledge on safety requirements for engineering industry.
- To learn safety requirement for chemical industry.
- To study the various safety measures adopted in construction industries.

Programme Outcomes (POs)

PO1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. 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

PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1. Implement new ideas on product / process development by utilizing the knowledge of design and manufacturing.

PSO2. Apply knowledge acquired in mechanical engineering with an analytical / computational tools to design, analyze and provide solutions for fluid flow and thermal related applications.

PSO3. Execute professional capabilities to competitively work in industries with global Standards by implementing recent tools and techniques.

Course Outcomes (COs)

1. Explain safety management system of an industry.
2. Implement the provisions of acts and rules in industries.
3. Implement and review the safety performance followed in various industries
4. Evaluate safety appraisal in chemical industries.
5. Generate safety reports on construction industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	2	1	-	1	-	-	-	-	-	2	2
2	-	-	-	-	1	-	-	3	-	-	-	-	2	1	-
3	2	-	-	-	-	-	-	-	-	-	-	3	1	-	2
4	2	3	-	-	-	-	-	-	2	-	-	-	2	-	1
5	-	-	-	-	2	-	-	-	-	3	-	-	-	3	-

UNIT I **9 Hours**

SAFETY MANAGEMENT

Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Reporting and Investigation - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.

UNIT II **9 Hours**

SAFETY AND LAW

Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, ,Building and other construction works act 1996, Electricity Rules.

UNIT III **9 Hours**

SAFETY IN ENGINEERING INDUSTRIES

Safety in machine shop,- Principles of machine guarding - Personal protective equipment- Safety in handling industrial gases - Safety in cold forming and hot working of metals- Safety in finishing, inspection and testing, heat treatment, electro plating, leak test, radiography.

UNIT IV **9 Hours**

SAFETY IN CHEMICAL INDUSTRIES

Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves -Plant commissioning and inspection, pressure vessel, Plant maintenance and emergency planning, management of maintenance HAZOP study.

UNIT V **9 Hours**

SAFETY IN CONSTRUCTION INDUSTRY

Construction regulations, contractual clauses, permit to work, - Education and training-Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high rise buildings - Working at heights,-Working on fragile roofs, work permit systems-Construction machinery, cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work, - Safety in confined spaces

Total: 45 Hours

Reference(s)

1. Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey,1973.
2. National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago, 1988
3. Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules , 1950, Madras
4. Environmental Pollution Control Act, 1986
5. BOCW Act,1996, Madras Book agency, Chennai-1
6. Explosive Act, 1884, Eastern Book Company, Lucknow -266 001.