SRM VALLIAMMAI ENGINEERING COLLEGE

(AN AUTONOMOUS INSTITUTION)

SRM Nagar, Kattankulathur-603203.

(An Autonomous Institution Affiliated to Anna University, Chennai, 'A' grade accredited by NAAC, NBA accredited ISO 9001: 2015 certified)

CURRICULA AND SYLLABI

B.E-AGRICULTURE ENGINEERING

REGULATION 2019

SRM VALLIAMMAI ENGINEERING COLLEGE

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B.E. AGRICULTURE ENGINEERING

REGULATIONS – 2019

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To train and educate students with general knowledge and skills in agricultural water management, agricultural production process, farm machinery and farm management.
2. To provide a sound theoretical knowledge in engineering principles applied to agriculture
3. To prepare students for a successful agricultural engineering career integrating all aspects of engineering in agriculture.
4. To develop innovative capacity of students for increasing agricultural production with scarce water resources available.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Agriculture Engineering Graduates will exhibit ability to:

PO	Graduate Attribute	Programme Outcome
1.	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2.	Problem analysis	Identify, formulate, research literature, and analyze complex engineering problems reaching

		substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3.	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4.	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5.	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.
6.	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7.	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8.	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9.	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10.	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.
11.	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12.	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.

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

1) Establish an Agricultural Engineering career in industry, government or academic field and achieve professional expertise as appropriate.
2) Execute innovation and excellence in Agricultural engineering problem solving and design in global and societal contexts.
3) Commit to lifelong learning and professional development in the agriculture engineering field to stay updated in technology, research topics and contemporary issues.
4) Understand the fundamentals of Agriculture engineering in commercial contexts and in expediting irrigation projects.

4. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1.	3	1	1	1	2	3	3	3	2	3	1	3	3	1	1	1
2.	2	3	3	3	3	2	3	2	2	2	3	3	2	3	3	3
3.	1	-	-	3	3	3	1	1	3	-	2	1	1	-	-	3
4.	3	-	-	1	3	3	3	-	3	3	2	3	3	-	-	1

Contribution: **1.Reasonable** **2. Significant** **3. Strong**

MAPPING – B.E- AGRICULTURE ENGINEERING

		Courses	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Year I	Semester I	Communicative English	3	3	3	2	3	3	2	0	0	3	0	1	2	1	1	1
		Engineering Mathematics-I	3	2	2	1	0	0	0	0	0	0	0	1	0	0	0	0
		Engineering Physics	3	1	1	1	1	1	1	0	0	0	0	1	3	0	0	0
		Engineering Chemistry	2	1	2	1	1	1	1	0	0	0	0	2	2	2	2	1
		Problem Solving and Python Programming	3	2	3	2	2	2	1	0	0	2	2	2	2	2	2	3
		Basic Electrical and Electronics for Agriculture Engineering	3	2	2	2	2	1	0	0	1	1	0	2	3	2	0	3
		Physics and Chemistry Laboratory	3	2	2	2	0	1	1	1	1	0	0	1	2	2	1	1
		Problem Solving and Python Programming Laboratory	3	2	2	1	3	2	0	1	0	0	2	3	2	3	2	3
Year I	Semester II	Technical English	3	2	2	2	0	0	0	0	3	3	2	1	1	1	1	1
		Engineering Mathematics-II	3	2	1	1	0	0	0	0	0	0	0	1	0	0	0	0
		Physics for Agriculture Engineering	3	1	2	2	2	2	2	1	2	0	2	2	3	3	3	3
		Environmental Science and Engineering	1	2	2	0	0	2	3	0	2	0	0	2	1	2	2	1
		Programming in C	3	2	3	2	2	1	1	0	2	0	1	1	3	2	2	3
		Engineering Graphics	2	0	3	0	0	0	0	0	1	3	0	1	2	1	1	1
		C Programming Laboratory	3	2	3	2	2	2	0	3	1	1	2	1	2	2	2	2

		Courses	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
		Engineering Practices Laboratory	3	2	2	2	2	1	0	0	1	0	1	1	3	2	2	2
		Applied Physics and Environmental Chemistry Laboratory	3	3	3	3	0	2	2	1	1	0	0	1	2	2	1	1
		NSS/NCC/YRC /NSO																
Year II	**Semester III**	Transforms and Partial Differential Equations	3	3	0	0	1	0	0	0	0	0	0	1	0	0	0	0
		Soil Science and Engineering	3	2	2	2	1	2	2	0	0	1	0	2	3	1	3	2
		Fluid Mechanics and Hydraulics	2	3	2	2	0	1	2	2	0	0	2	3	3	2	2	3
		Theory of Machines	3	2	2	0	2	0	0	1	0	0	0	1	3	0	1	0
		Surveying and Leveling	2	3	0	3	1	2	2	2	2	2	2	2	2	2	3	3
		Solar and Wind Energy Engineering	2	2	1	2	2	2	3	0	0	0	2	2	2	2	2	2
		Surveying and Leveling Laboratory	3	3	2	2	1	2	2	2	3	2	2	3	3	2	3	3
		Fluid Mechanics Laboratory	3	3	2	2	0	1	2	2	0	0	2	3	3	2	2	3
		Communication skills Laboratory - Project Based	3	3	2	2	3	0	3	0	0	3	0	1	2	2	2	2
Year II	**Semester IV**	Probability and Statistics	3	3	3	0	0	0	0	0	0	0	0	0	0	0	1	0
		Unit Operations in Agricultural Processing	2	1	2	2	1	0	2	0	2	0	1	2	3	2	2	3
		Farm Tractors	2	2	1	2	2	1	2	1	1	0	1	2	2	1	1	0
		Hydrology and Water Resources Engineering	2	3	2	2	2	2	2	2	1	1	2	2	2	2	2	2
		Strength of Materials	2	2	2	1	1	1	0	0	1	0	2	2	2	2	2	3

		Courses	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
		Principles and Practices of Crop Production	2	2	2	2	1	2	2	1	1	0	2	2	2	2	2	2
		Soil Science Laboratory	1	1	1	2	2	1	1	1	1	1	1	2	2	2	2	1
		Strength of Materials Laboratory	2	2	2	2	2	1	0	1	1	1	1	2	2	2	2	1
		Crop Husbandry Laboratory	3	1	2	2	2	1	3	2	2	2	2	2	2	2	2	1
Year III	**Semester V**	Irrigation and Drainage Engineering	1	1	2	2	2	2	2	1	2	1	1	3	2	2	3	2
		Farm Machinery and Equipment	2	1	2	2	3	2	2	1	2	1	2	1	1	2	2	2
		Design of Basic Machine Elements	2	2	3	0	0	0	0	1	0	0	0	2	3	3	0	0
		Post-Harvest Technology	2	2	2	2	2	1	3	2	2	2	3	1	3	1	2	3
		Professional Elective - I																
		Open Elective - I																
		Operation and Maintenance of Farm Machinery Lab	2	2	2	1	2	1	2	1	1	0	1	1	2	2	2	2
		Post-Harvest Engineering Laboratory	2	2	2	2	2	1	2	2	2	2	2	2	2	1	2	2
		Irrigation Field Laboratory	2	2	2	2	2	1	2	2	2	2	2	2	2	1	2	2
		Professional Communication	3	2	2	3	3	0	3	0	0	3	0	1	2	2	1	1
Year III	**Semester VI**	Groundwater and Well Engineering	3	3	3	2	2	1	1	1	2	2	3	2	1	2	2	1
		Food and Dairy Engineering	1	1	2	1	2	2	3	2	1	2	2	2	2	1	2	2
		Protected Cultivation	1	2	2	2	3	2	2	1	1	1	1	2	2	1	2	2
		Professional Elective – II																

		Courses	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
		Professional Elective – III																
		CAD for Agricultural Engineering	2	2	3	1	2	2	2	1	2	2	1	2	2	1	3	2
		Food Process Engineering Laboratory	0	1	2	2	1	2	2	0	0	1	1	2	3	2	2	2
		Mini Project	2	2	3	2	2	1	1	0	3	2	2	2	2	2	3	2
2 **Year IV**	**Semester VII**	Soil and Water Conservation Engineering	1	2	2	2	0	0	1	0	0	0	0	2	2	1	2	3
		Remote Sensing and Geographical Information System for Agriculture Engineers	3	2	2	2	2	3	1	2	0	1	2	2	1	2	1	1
		Bio-Energy Resource Technology	2	2	1	2	0	1	2	0	0	0	2	1	2	1	2	2
		Professional Elective – IV																
		Open Elective - II																
		Design, Drawing of Farm and Irrigation Structures	2	2	2	1	0	0	0	0	0	0	1	1	1	0	2	2
		Internship Training (2 Weeks)	3	2	2	1	0	0	0	0	2	2	1	2	2	1	1	2
		Project Work (Phase-I)	3	2	2	1	0	0	0	0	2	2	1	2	2	1	1	2
Year IV	**Semester VIII**	Professional Elective – V																
		Professional Elective – VI																
		Project Work (Phase-II)	3	2	2	1	0	0	0	0	2	2	1	2	2	1	1	2

PROFESSIONAL ELECTIVES

Courses	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Systems Analysis and Soft Computing in Agricultural Engineering	2	2	2	1	2	2	2	0	0	2	0	1	2	2	2	1
IT in Agricultural Systems	2	0	0	2	2	2	2	0	0	0	2	1	2	0	2	1
Climate change and adaptation	2	2	1	2	2	2	2	0	0	0	0	1	2	2	2	2
Micro Irrigation	1	2	2	0	2	1	1	0	0	0	2	1	2	1	1	2
Agricultural Business Management	1	0	0	0	2	1	2	0	0	0	2	1	2	0	1	3
Agricultural Economics and Farm Management	1	1	0	1	1	1	0	2	0	2	2	1	2	1	1	1
Agricultural Extension	1	0	1	2	2	0	0	0	2	2	1	1	2	1	1	2
Total Quality Management	0	1	1	0	2	0	2	0	0	0	1	0	0	0	0	0
Intellectual Property Rights	1	2	2	3	2	2	2	2	0	0	2	0	3	2	2	2
Agricultural Waste Management	1	1	0	0	1	1	1	0	0	0	1	1	2	0	1	1
Sustainable Agriculture and Food Security	1	1	1	1	1	1	3	0	0	0	2	1	1	0	0	1
Refrigeration and Air Conditioning for Agricultural Engineers	3	2	1	1	0	0	0	0	0	0	0	1	0	1	0	1
Seed Processing Technology	1	1	0	1	2	2	1	0	0	0	2	0	2	0	0	1
Disaster Management	1	2	1	2	1	2	2	1	2	2	1	2	2	1	1	3
Storage and Packaging Technology	2	2	0	2	3	3	2	2	2	2	2	2	3	3	2	2
Heat and Mass Transfer for Agricultural Engineers	3	2	1	1	0	0	0	0	0	0	0	1	0	1	0	1

Courses	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Process Engineering of Fruits and Vegetables	2	3	0	2	3	3	2	3	0	2	0	2	2	3	2	3
Foundation Skills In Integrated Product Development	3	2	3	2	3	2	3	3	2	3	3	2	2	3	3	3
Watershed Management	2	2	2	3	3	3	2	2	1	2	2	2	3	3	2	2
On Farm Water Management	2	3	0	3	3	3	2	2	2	0	2	2	3	3	3	2
Automation in Irrigation	3	2	3	2	2	2	2	2	2	3	3	2	3	3	2	3
Professional Ethics	0	0	0	0	0	3	3	2	0	0	0	0	0	0	0	0
Farm Power and Machinery Management	3	3	3	3	3	0	2	2	0	2	2	1	2	2	3	0
Mechanics of Tillage and Traction	2	3	0	2	3	2	3	3	0	2	2	2	2	3	2	3
Special Farm Equipment	3	3	3	3	3	0	2	2	0	2	2	1	0	2	3	0
Energy Auditing and Management	2	2	2	1	2	1	2	0	0	0	2	3	2	2	3	2
Ergonomics and Safety in Agricultural Engineering	3	2	3	0	2	2	2	2	2	3	3	2	2	2	3	3

Contribution: **1. Reasonable** **2. Significant** **3. Strong**

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B.E. AGRICULTURE ENGINEERING
REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

CURRICULA & SYLLABI (I – VIII SEMESTERS)

SEMESTER I

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	1919101	Communicative English	HS	3	3	0	0	3
2	1918102	Engineering Mathematics-I	BS	4	3	1	0	4
3	1920103	Engineering Physics	BS	3	3	0	0	3
4	1921104	Engineering Chemistry	BS	3	3	0	0	3
5	1901005	Problem Solving and Python Programming	ES	3	3	0	0	3
6	1901107	Basic Electrical and Electronics for Agriculture Engineering	ES	3	3	0	0	3
PRACTICAL								
7	1901108	Physics and Chemistry Laboratory	BS	4	0	0	4	2
8	1901009	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
			TOTAL	**27**	**18**	**1**	**8**	**23**

SEMESTER II

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	1919201	Technical English	HS	3	3	0	0	3
2	1918202	Engineering Mathematics-II	BS	4	3	1	0	4
3	1920205	Physics for Agriculture Engineering	BS	3	3	0	0	3
4	1921203	Environmental Science and Engineering	BS	3	3	0	0	3
5	1901006	Programming in C	ES	3	3	0	0	3
6	1901007	Engineering Graphics	ES	6	2	0	4	4
PRACTICAL								
7	1901010	C Programming Laboratory	ES	4	0	0	4	2
8	1901208	Engineering Practices Laboratory	ES	4	0	0	4	2
9	1901209	Applied Physics and Environmental Chemistry Laboratory	BS	4	0	0	4	2
10	1901200	NSS/NCC/YRC/NSO	PCD	2*	0	0	2	1
			TOTAL	**36**	**17**	**1**	**18**	**27**

***** conducted after college hours

SEMESTER III

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1918301	Transforms and Partial Differential Equations	BS	4	3	1	0	4
2.	1902301	Soil Science and Engineering	PC	3	3	0	0	3
3.	1902302	Fluid Mechanics and	PC	3	3	0	0	3

		Hydraulics						
4.	1909308	Theory of Machines	PC	3	3	0	0	3
5.	1902303	Surveying and Leveling	ES	3	3	0	0	3
6.	1905309	Solar and Wind Energy Engineering	PC	3	3	0	0	3
PRACTICAL								
7.	1902304	Surveying and Leveling Laboratory	ES	4	0	0	4	2
8.	1902305	Fluid Mechanics Laboratory	PC	2	0	0	2	1
9.	1919001	Communication skills Laboratory - Project Based	EEC	2	0	0	2	0
			TOTAL	**27**	**18**	**1**	**8**	**22**

SEMESTER IV

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1918404	Probability and Statistics	BS	4	3	1	0	4
2.	1902401	Unit Operations in Agricultural Processing	PC	3	3	0	0	3
3.	1909407	Farm Tractors	PC	3	3	0	0	3
4.	1902402	Hydrology and Water Resources Engineering	PC	3	3	0	0	3
5.	1902403	Strength of Materials	ES	3	3	0	0	3
6.	1902404	Principles and Practices of Crop Production	PC	3	3	0	0	3
PRACTICAL								
7.	1902405	Soil Science Laboratory	PC	2	0	0	2	1
8.	1902406	Strength of Materials Laboratory	ES	4	0	0	4	2

9.	1902407	Crop Husbandry Laboratory	PC	4	0	0	4	2
			TOTAL	**29**	**18**	**1**	**10**	**24**

SEMESTER V

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1902501	Irrigation and Drainage Engineering	PC	3	3	0	0	3
2.	1902502	Farm Machinery and Equipment	PC	3	3	0	0	3
3.	1909515	Design of Basic Machine Elements	PC	3	3	0	0	3
4.	1902503	Post-Harvest Technology	PC	3	3	0	0	3
5.	19xxxxx	Professional Elective - I	PE	3	3	0	0	3
6.	19xxxxx	Open Elective - I	OE	3	3	0	0	3
PRACTICAL								
7.	1902508	Operation and Maintenance of Farm Machinery Lab	PC	4	0	0	4	2
8.	1902509	Post Harvest Engineering Laboratory	PC	4	0	0	4	2
9.	1902510	Irrigation Field Laboratory	PC	4	0	0	4	2
10.	1919002	Professional Communication	EEC	2	0	0	2	1
			TOTAL	**32**	**18**	**0**	**14**	**25**

SEMESTER VI

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1902601	Groundwater and Well Engineering	PC	3	3	0	0	3
2.	1902602	Food and Dairy Engineering	PC	3	3	0	0	3

3.	1902603	Protected Cultivation	PC	3	3	0	0	3
4.	19xxxxx	Professional Elective – II	PE	3	3	0	0	3
5.	19xxxxx	Professional Elective – III	PE	3	3	0	0	3
PRACTICAL								
6.	1902610	CAD for Agricultural Engineering	PC	4	0	0	4	2
7.	1902611	Food Process Engineering Laboratory	PC	4	0	0	4	2
8.	1902612	Mini Project	EEC	4	0	0	4	2
			TOTAL	**27**	**15**	**0**	**12**	**21**

SEMESTER VII

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1902701	Soil and Water Conservation Engineering	PC	3	3	0	0	3
2.	1902702	Remote Sensing and Geographical Information System for Agriculture Engineers	PC	3	3	0	0	3
3.	1902703	Bio-Energy Resource Technology	PC	3	3	0	0	3
4.	19xxxxx	Professional Elective – IV	PE	3	3	0	0	3
5.	19xxxxx	Open Elective - II	OE	3	3	0	0	3
PRACTICAL								
6.	1902707	Design and Drawing of Farm and irrigation Structures	PC	4	0	0	4	2
7.	1902708	Internship	EEC	0	0	0	0	1
8.	1902709	Project Work – Phase I	EEC	4	0	0	4	2
			TOTAL	**23**	**15**	**0**	**8**	**20**

SEMESTER VIII

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	19xxxxx	Professional Elective – V	PE	3	3	0	0	3
2.	19xxxxx	Professional Elective – VI	PE	3	3	0	0	3
PRACTICAL								
3.	1902808	Project Work – Phase II	EEC	12	0	0	12	6
			TOTAL	**18**	**6**	**0**	**20**	**12**

TOTAL NO. OF CREDITS: 174

PROFESSIONAL ELECTIVE

SEMESTER V

ELECTIVE -I

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1902504	Systems Analysis and Soft Computing in Agricultural Engineering	PE	3	3	0	0	3
2.	1902505	IT in Agricultural Systems	PE	3	3	0	0	3
3.	1902506	Climate change and adaptation	PE	3	3	0	0	3
4.	1902507	Micro Irrigation	PE	3	3	0	0	3
5.	1905511	Energy Auditing and Management	PE	3	3	0	0	3

SEMESTER VI
ELECTIVE -II

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1902604	Agricultural Business Management	PE	3	3	0	0	3
2.	1902605	Agricultural Economics and Farm Management	PE	3	3	0	0	3
3.	1915001	Professional Ethics	PE	3	3	0	0	3

4.	1915003	Total Quality Management	PE	3	3	0	0	3
5.	1904606	Intellectual Property Rights	PE	3	3	0	0	3

SEMESTER VI
ELECTIVE –III

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1902607	Agricultural Waste Management	PE	3	3	0	0	3
2.	1902608	Sustainable Agriculture and Food Security	PE	3	3	0	0	3
3	1909612	Refrigeration and Air Conditioning for Agricultural Engineers	PE	3	3	0	0	3
4	1902609	Seed Processing Technology	PE	3	3	0	0	3
5.	1903612	Disaster Management	PE	3	3	0	0	3

SEMESTER VII
ELECTIVE -IV

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1902704	Storage and Packaging Technology	PE	3	3	0	0	3
2.	1909717	Heat and Mass Transfer for Agricultural Engineers	PE	3	3	0	0	3
3.	1902705	Process Engineering of Fruits and Vegetables	PE	3	3	0	0	3
4.	1902706	Foundation Skills In Integrated Product Development	PE	3	3	0	0	3

SEMESTER VIII

ELECTIVE -V

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1902801	Watershed Management	PE	3	3	0	0	3
2.	1902802	On Farm Water Management	PE	3	3	0	0	3
3.	1902803	Automation in Irrigation	PE	3	3	0	0	3
4.	1902804	Agricultural Extension	PE	3	3	0	0	3

SEMESTER VIII

ELECTIVE -VI

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1902805	Farm Power and Machinery Management	PE	3	3	0	0	3
2.	1902806	Mechanics of Tillage and Traction	PE	3	3	0	0	3
3.	1902807	Special Farm Equipment	PE	3	3	0	0	3
4.	1902808	Ergonomics and Safety in Agricultural Engineering	PE	3	3	0	0	3

OPEN ELECTIVE LIST- GROUP I (5th Semester)

Sl. No	COURSE CODE	COURSE TITLE	COURSE OFFERING DEPT	CONTACT PERIODS	L	T	P	C
1.	1903514	Air Pollution and Control Engineering	CIVIL	3	3	0	0	3
2.	1903515	Participatory Water Resources Management	CIVIL	3	3	0	0	3

3.	1921501	Advanced Engineering Chemistry	CHEM	3	3	0	0	3
4.	1921502	Industrial Nanotechnology	CHEM	3	3	0	0	3
5.	1904007	Data Structures	CSE	3	3	0	0	3
6.	1904504	Geographic Information System	CSE	3	3	0	0	3
7.	1904508	Database Management System	CSE	3	3	0	0	3
8.	1904509	Cloud Computing	CSE	3	3	0	0	3
9.	1906505	Photonic Networks	ECE	3	3	0	0	3
10.	1906506	Telecommunication Network Management	ECE	3	3	0	0	3
11.	1906507	Entertaintronics	ECE	3	3	0	0	3
12.	1905001	Energy Conservation And Management	EEE	3	3	0	0	3
13.	1905508	Renewable Energy Sources	EEE	3	3	0	0	3
14.	1905509	SCADA System Management	EEE	3	3	0	0	3
15.	1907503	Sensors And Transducers	EIE	3	3	0	0	3
16.	1907504	Instrumentation In Biomedical Engineering	EIE	3	3	0	0	3
17.	1908001	3D Printing and Design	IT	3	3	0	0	3
18.	1908002	Scripting Languages	IT	3	3	0	0	3
19.	1910504	Principles of Food Preservation	M.ELE	3	3	0	0	3
20.	1909510	Product Design and Development	MECH	3	3	0	0	3
21.	1909511	Vibration and Noise Control	MECH	3	3	0	0	3
22.	1909512	Industrial Safety Engineering	MECH	3	3	0	0	3

23.	1920501	Nanotechnology	PHY	3	3	0	0	3
24.	1920502	Microscopy	PHY	3	3	0	0	3

OPEN ELECTIVE LIST- GROUP I (7th Semester)

Sl. No	COURSE CODE	COURSE TITLE	COURSE OFFERING DEPT	CONTACT PERIODS	L	T	P	C
1.	1903706	Green Building Design	CIVIL	3	3	0	0	3
2.	1903716	Environmental and Social impact Assessment	CIVIL	3	3	0	0	3
3.	1921701	Waste water Treatment	CHEM	3	3	0	0	3
4.	1904703	Tamil Computing	CSE	3	3	0	0	3
5.	1904010	Object Oriented Programming	CSE	3	3	0	0	3
6.	1904712	Software Engineering	CSE	3	3	0	0	3
7.	1906705	Acoustics	ECE	3	3	0	0	3
8.	1906706	Visual Communication	ECE	3	3	0	0	3
9.	1906707	MEMS and NEMS	ECE	3	3	0	0	3
10.	1905711	Electrical Circuits	EEE	3	3	0	0	3
11.	1905712	Renewable Energy Systems	EEE	3	3	0	0	3
12.	1905713	Electric Vehicles and Power Management	EEE	3	3	0	0	3
13.	1907001	Transducers Engineering	EIE	3	3	0	0	3
14.	1907003	Process Modeling and Simulation	EIE	3	3	0	0	3
15.	1907708	State Variable Analysis and Design	EIE	3	3	0	0	3
16.	1908003	Software Quality Management	IT	3	3	0	0	3
17.	1908004	C# and .Net Programming	IT	3	3	0	0	3

18.	1908005	Virtual Reality	IT	3	3	0	0	3
19.	1910703	Clinical Trials	M.ELECT	3	3	0	0	3
20.	1910704	Regulatory Requirements in Pharmaceutical Industries	M.ELECT	3	3	0	0	3
21.	1910705	Microbiology	M.ELECT	3	3	0	0	3
22.	1909718	Robotics	MECH	3	3	0	0	3
23.	1909719	Testing of materials	MECH	3	3	0	0	3
24.	1909720	Design of Electric Vehicles	MECH	3	3	0	0	3
25.	1920701	Analytical Methods and Instrumentation	PHY	3	3	0	0	3
26.	1920702	Medical Physics	PHY	3	3	0	0	3
27.	1920703	Electronic Materials	PHY	3	3	0	0	3

HUMANITY AND SOCIAL SCIENCES (HS)

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1919101	Communicative English	HS	3	3	0	0	3
2.	1919201	Technical English	HS	3	3	0	0	3

BASIC SCIENCES (BS)

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1918102	Engineering Mathematics-I	BS	4	3	1	0	4
2.	1920103	Engineering Physics	BS	3	3	0	0	3
3.	1921104	Engineering Chemistry	BS	3	3	0	0	3
4.	1901108	Physics and Chemistry Laboratory	BS	4	0	0	4	2

5.	1918202	Engineering Mathematics-II	BS	4	3	1	0	4
6.	1920205	Physics for Agricultural Engineering	BS	3	3	0	0	3
7.	1921203	Environmental Science and Engineering	BS	3	3	0	0	3
8.	1901209	Applied Physics and Environmental Chemistry Laboratory	BS	4	0	0	4	2
9.	1918301	Transforms and Partial Differential Equations	BS	3	3	1	0	4
10.	1918404	Probability and Statistics	BS	3	3	1	0	4

ENGINEERING SCIENCES (ES)

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1901005	Problem Solving and Python Programming	ES	3	3	0	0	3
2.	1901107	Basic Electrical and Electronics for Agriculture Engineering	ES	3	3	0	0	3
3.	1901009	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
4.	1901006	Programming in C	ES	3	3	0	0	3
5.	1901007	Engineering Graphics	ES	6	2	0	4	4
6.	1901010	C Programming Laboratory	ES	4	0	0	4	2
7.	1901208	Engineering Practices Laboratory	ES	4	0	0	4	2
8.	1902303	Surveying and Leveling	ES	3	3	0	0	3
9.	1902304	Surveying and Leveling Laboratory	ES	4	0	0	4	2
10.	1902403	Strength of Materials	ES	3	3	0	0	3
11	1902406	Strength of Materials Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1902301	Soil Science and Engineering	PC	3	3	0	0	3
2.	1902302	Fluid Mechanics and Hydraulics	PC	3	3	0	0	3
3.	1909308	Theory of Machines	PC	3	3	0	0	3
4.	1905309	Solar and Wind Energy Engineering	PC	3	3	0	0	3
5.	1902305	Fluid Mechanics Laboratory	PC	2	0	0	2	1
6.	1902401	Unit Operations in Agricultural Processing	PC	3	3	0	0	3
7.	1909407	Farm Tractors	PC	3	3	0	0	3
8.	1902402	Hydrology and Water Resources Engineering	PC	3	3	0	0	3
9.	1902404	Principles and Practices of Crop Production	PC	3	3	0	0	3
10.	1902405	Soil Science Laboratory	PC	2	0	0	2	1
11.	1902407	Crop Husbandry Laboratory	PC	4	0	0	4	2
12.	1902501	Irrigation and Drainage Engineering	PC	3	3	0	0	3
13.	1902502	Farm Machinery and Equipment	PC	3	3	0	0	3
14.	1909515	Design of Basic Machine Elements	PC	3	3	0	0	3
15.	1902503	Post Harvest Technology	PC	3	3	0	0	3
16.	1902508	Operation and Maintenance of Farm Machinery Lab	PC	4	0	0	4	2
17.	1902509	Post-Harvest Engineering Laboratory	PC	4	0	0	4	2
18.	1902510	Irrigation Field Laboratory	PC	4	0	0	4	2
19.	1902601	Groundwater and Well Engineering	PC	3	3	0	0	3

20.	1902602	Food and Dairy Engineering	PC	3	3	0	0	3
21.	1902603	Protected Cultivation	PC	3	3	0	0	3
22.	1902610	CAD for Agricultural Engineering	PC	4	0	0	4	2
23.	1902611	Food Process Engineering Laboratory	PC	4	0	0	4	2
24.	1902701	Soil and Water Conservation Engineering	PC	3	3	0	0	3
25.	1902702	Remote Sensing and Geographical Information System for Agriculture Engineers	PC	3	3	0	0	3
26.	1902703	Bio-Energy Resource Technology	PC	3	3	0	0	3
27.	1902707	Design and Drawing of Farm and irrigation Structures	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1919001	Communication skills Laboratory - Project Based	EEC	2	0	0	2	0
2.	1919002	Professional Communication	EEC	2	0	0	2	1
3.	1902612	Mini Project	EEC	4	0	0	4	2
4.	1902708	Internship	EEC	0	0	0	0	1
5.	1902709	Project Work – Phase I	EEC	4	0	0	4	2
6.	1902808	Project Work – Phase II	EEC	12	0	0	12	6

PERSONALITY AND CHARACTER DEVELOPMENT (PCD)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1901200	NSS/NCC/YRC/NSO	PCD	2	0	0	2	1

SUMMARY

DEPARTMENT OF AGRICULTURE ENGINEERING

S. No	Subject Area	Credits per Semester								Credits Total	%
		I	II	III	IV	V	VI	VII	VIII		
1	**HS**	3	3							6	3.45
2	**BS**	12	12	4	4					32	18.39
3	**ES**	8	11	5	5					29	16.67
4	**PC**			13	15	18	13	11		70	40.23
5	**PE**					3	6	3	6	18	10.34
6	**OE**					3		3		6	3.45
7	**EEC**			0		1	2	3	6	12	6.90
8	**PCD**		1							1	0.57
	Total	**23**	**27**	**22**	**24**	**25**	**21**	**20**	**12**	**174**	**100**
	Non Credit / Mandatory	**-**	**-**	✓	**-**	**-**	**-**	**-**	**-**	**-**	**-**

TOTAL CREDITS = 174

SEMESTER I

1919101	COMMUNICATIVE ENGLISH	L	T	P	C
	(Common to all branches of B.E. / B.Tech. Programmes)	3	0	0	3

OBJECTIVES:

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- Comprehend content - asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT-I: SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 9

Reading– short comprehension passages, practice in skimming-scanning and predicting- **Writing**– Blog/film review/quora/Twitter/Facebook– developing hints. **Listening**– short texts- short formal and informal conversations. **Speaking-** introducing oneself – exchanging personal information- **Language development**– Wh- Questions- asking and answering-yes or no questions- parts of speech. **Vocabulary development-**– prefixes-suffixes – word formation: making sentences of your own.

UNIT-II: GENERAL READING AND FREE WRITING 9

Reading – Story with questions and answers- **Writing** – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –**Listening**– Listening to a speech – answering questions. **Speaking –** Presentation with PPT - **Language development** – prepositions, **Vocabulary development-** guessing meanings of words in contexts – articles.

UNIT-III: GRAMMAR AND LANGUAGE DEVELOPMENT 9

Reading– short texts (close reading) **Writing-** understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences **Listening** – listening to stories to answer questions. **Speaking**– asking about routine actions and expressing opinions. **Language development**– Adjectives, degrees of comparison-conjunctions and connectives - **Vocabulary development –** single word substitutes-adverbs.

UNIT-IV: READING AND LANGUAGE DEVELOPMENT **9**

Reading- Newspaper articles- answering questions **Writing**– letter writing, informal or personal letters- congratulating/ thanking/requesting help/ e-mails-forward a mail to Staff on given topic- **Listening**– listen to different sounds and differentiate the sounds with different words. **Speaking-** speaking about oneself- speaking about one's friend- **Language development-** Modals -Tenses - **Vocabulary development**– synonyms-antonyms- phrasal verbs.

UNIT-V: EXTENDED WRITING **9**

Reading- longer texts- close reading –**Writing**– brainstorming -writing short essays **–** developing an outline- identifying main and subordinate ideas- dialogue writing- **Listening** – listening to talks- Note taking- **Speaking –** participating in conversations-short group conversations-**Language development**- correction of errors- **Vocabulary development**-collocations- fixed and semi-fixed expressions.

TOTAL: 45 PERIODS

OUTCOMES:

At the End of the Course, Learners will be able to:

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations.
- Introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. **Using English A** Course book for Undergraduate Engineers and Technologists**.** Orient Black Swan Limited, Hyderabad: 2015

2. Richards, C. Jack. **Interchange Students' Book-2** New Delhi: CUP, 2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Means,L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face2Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013.
6. Preliminary English Test – Cambridge University Press ESOL
7. Key English Test - Cambridge University Press ESOL.
8. Pronunciation Dictionary - Daniel Jones.

CO	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	3	2	3	3	-	-	-	-	3	-	1	2	1	1	1
2	3	2	3	2	2	-	2	-	-	3	-	1	2	1	1	-
3	3	3	-	2	-	-	-	-	-	3	-	1	1	1	1	1
4	3	3	-	-	-	-	3	-	-	3	-	1	1	1	1	-
5	3	3	3	2	3	3	2	-	-	3	-	1	2	2	1	1

No Correlation - Low 1 Medium 2 High 3

1918102	ENGINEERING MATHEMATICS – I	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand and apply matrix techniques for engineering applications.
- To familiarize the student with basic calculus and traditions of traditional calculus.
- To solve the problems in single and multivariable calculus and plays an important role in science, economics, engineering.
- To acquaint the student with mathematical tools needed in evaluating integrals.
- To familiarize the student with multiple integrals and their usage in find the area and volume of two and three dimensional objects.

UNIT-I: MATRICES **9L+3T**

System of equations – consistency and inconsistency- Eigen values and Eigen vectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigen vectors - Statement and Applications of Cayley-Hamilton Theorem - Reduction of a quadratic form into canonical form by orthogonal transformation

UNIT-II: DIFFERENTIAL CALCULUS FOR FUNCTIONS OF ONE VARIABLE 9L+3T

Limit of a function - Continuity – Differentiability - Differentiation rules – Rolle's theorem and Mean Value theorem – Taylor's series- Maxima and Minima of functions of one variable.

UNIT-III: FUNCTIONS OF SEVERAL VARIABLES **9L+3T**

Partial derivatives - Total derivatives - Jacobians and properties - Taylor's series for functions of two variables - Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers.

UNIT-IV: INTEGRAL CALCULUS FOR FUNCTION OF ONE VARIABLE 9L+3T

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration by

partial fractions- Improper integrals

UNIT-V: MULTIPLE INTEGRALS **9L+3T**

Double integrals in Cartesian and polar coordinates - Change of order of integration - Area enclosed by plane curves - Change of variables in double integrals (Polar coordinates) - Triple integrals - Volume of solids.

TOTAL: 45L +15T PERIODS

OUTCOMES:

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

- To apply the idea of reducing complex problems into simple form using matrix technique.
- Basic application of calculus in Engineering problems and to tackle for different geometries.
- This course equips the students to have basic knowledge and understanding of fundamental statistics to analyze and interpret data.
- To apply Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration by partial fractions in Engineering Problems.
- Basic application of Double and Triple integrals used in Engineering real life problems

TEXT BOOKS:

1. Grewal. B.S, **"Higher Engineering Mathematics",** 41st Edition, Khanna Publications, Delhi, 2011.
2. Veerarajan. T, **"Engineering Mathematics"**, McGraw Hill Education (India) Private Limited, 2019.
3. Gupta S.C and Kapoor V.K, **"Fundamentals of Mathematical Statistics"**, S.Chand Private Ltd., 11th Edition, 2005.

REFERENCE BOOKS:

1. Kreyszig Erwin, **"Advanced Engineering Mathematics"**, John Wiley and Sons, 10thEdition, New Delhi, 2016

2. Ramana B.V, **"Higher Engineering Mathematics"**, Tata McGraw Hill Publishing Company, New Delhi, 2008.
3. James Stewart, **"Calculus: Early Transcendentals"**, Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
2	3	2	2	1	-	-	-		-	-	-	1	-	-	-	-
3	3	2	2	1	-	-	-		-	-	-	1	-	-	-	-
4	3	2	2	1	-	-	-		-	-	-	1	-	-	-	-
5	3	2	2	1	-	-	-		-	-	-	1	-	-	-	-

1920103 **ENGINEERING PHYSICS** **L T P C**

(Common to all branches of B.E. / B.Tech. Programmes) **3 0 0 3**

OBJECTIVES:

- To understand the stress, strain and the concept of Hooke's law for the modulus of elasticity values .
- To facilitate the knowledge about basics of laser, optical fiber sources and transmission techniques.
- To enrich the idea of transfer and measurement of heat and uses of heat exchangers.
- To explore the basics of quantum theory and atomic and subatomic particles.
- To enhance the fundamental knowledge crystal Physics and its applications

UNIT-I: PROPERTIES OF MATTER **9**

Elasticity – Hooke's law-Stress-strain diagram and its uses –Poisson ratio-factors affecting elastic modulus and tensile strength – twisting couple - torsion pendulum: theory and experiment (regular body) - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders.

UNIT-II: LASERS AND FIBER OPTICS **9**

Lasers: population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG laser-Semiconductor lasers: homojunction and heterojunction – Applications. Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, and mode) – losses associated with optical fibers–Fiber optic communication- fibre optic sensors: pressure and displacement- Endoscope.

UNIT-III: THERMAL PHYSICS **9**

Transfer of heat energy – thermal conduction, convection and radiation – Newton's law cooling (qualitative) -heat conductions in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT-IV: QUANTUM PHYSICS **9**

Black body radiation – Planck's theory (derivation)- deduction of Wien's and Rayleigh jeans law – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional - three dimensional potential box– tunnelling (qualitative) - scanning tunnelling microscope.

UNIT-V: CRYSTAL PHYSICS **9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell,

crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances- coordination number and packing factor for SC, BCC, FCC, HCP and diamond structure (qualitative) - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques - Importance of crystal physics.

TOTAL: 45 PERIODS

OUTCOMES:

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

- The students will gain knowledge on the basics of properties of matter and its applications,
- The students will acquire knowledge on the concepts of optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of material and their applications in heat exchanger and electrical appliances,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunnelling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. “Engineering Physics”. Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. “Engineering Physics”. Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. &Chaturvedi, S. “Engineering Physics”. Cengage Learning India, 2012.
4. Brijlal and Subramanyam, “Properties of Matter”, S .Chand publishing, 2002.

REFERENCE BOOKS:

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2010.

3. Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’. W.H.Freeman, 2007.
4. Shatendra Sharma & Jyotsna Sharma, “Engineering Physics”. Pearson, 2018.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1			1	1	-	-	-	-	1	2	-	-	-
2	3	1	1		1	1	1	-	-	-		1	3	-	-	-
3	3		1			1		-	-	-	-	1	3	-	-	-
4	3	1		1		1	1	-	-	-	-	1	3	-	-	-
5	3	1		1			1	-	-	-		1	2	-	-	-

1921104 ENGINEERING CHEMISTRY L T P C

(Common to all branches of B.E. / B.Tech Programmes) **3 0 0 3**

OBJECTIVES:

- To make the students acquainted with boiler feed water requirements, related problems and domestic water treatment techniques.
- To understand the basic mechanism of surface phenomenon.
- To acquaint the student with the principles of electrochemical reactions, methods for corrosion prevention and protection of materials.
- To make the student conversant with the basics of polymers, cement and glass.
- To acquaint the students with the basics of nanomaterials, their properties and applications.

UNIT-I: WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units - Boiler feed water-boiler troubles - scale and sludge, priming and foaming, caustic embrittlement, boiler corrosion. Treatment of boiler feed water – Internal treatment (phosphate, colloidal,

sodium aluminate and calgon conditioning). External treatment – Ion exchange process – domestic water treatment (break point chlorination) – Desalination of brackish water – Reverse Osmosis.

UNIT-II: SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms. Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Contact theory. Kinetics of surface reactions, unimolecular reactions, Langmuir – applications of adsorption on pollution abatement. Catalysis: Catalyst – types of catalysis – Criteria – Autocatalysis – Catalytic poison and catalytic promoters – Acid base catalysis – Applications (3 way catalytic convertor) – Enzyme catalysis– Michaelis – Menten equation.

UNIT-III: ELECTROCHEMISTRY, CORROSION AND PROTECTIVE COATINGS 9

Electrochemical cell - redox reaction, electrode potential - origin of electrode potential - oxidation potential - reduction potential, measurement and applications - Electrochemical series and its significance - Nernst equation (derivation and problems). Corrosion – causes – factors – types - chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control – material selection and design aspects – Electrochemical protection – sacrificial anode method and impressed current cathodic method. Protective coatings: Metallic coatings – Electroplating of Cu - electroless plating of Ni. Organic coatings: Paints - constituents and function.

UNIT-IV: ENGINEERING MATERIALS 9

Cement: Definition – classification of cement – Portland cement - manufacture and properties - setting and hardening of cement - special cement, water proof, white and sorel cement – properties and uses – Glass: Manufacture, types, properties and uses (laminated, safety and flint glass) - Polymers: Classification - types of polymerization - mechanism - methods of polymerization - Engineering polymers: Nylon-6, Nylon-6,6, Teflon, Kevlar and PEEK - preparation, properties and uses - Plastic and its types - Conducting polymers: Types and applications - Polymers in medicine and surgery

(applications).

UNIT-V: NANOCHEMISTRY **9**

Basics - distinction between molecules, nanoparticles and bulk materials; size- dependent properties (surface to volume ratio, melting point, optical and electrical). Nanoparticles, Nanocluster, Nanorods, Nanotube (CNT: SWNT and MWNT) and Nanowire, Synthesis - precipitation, thermolysis, hydrothermal, electrodeposition, chemical vapour deposition, laser ablation, sol-gel process and applications.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to

- Gain idea about various methods available for water treatment.
- Explain the materials surface engineering.
- Understand the process of electrochemistry and its application to corrosion.
- Appreciate the nature and novelty of engineering materials.
- Ability to understand the nature and uses of nanomaterials.

TEXT BOOKS:

1. Shikha Agarwal, **"Engineering Chemistry - Fundamentals and Applications"**, Cambridge University Press, Delhi, 2015.
2. P. C. Jain and Monika Jain, **"Engineering Chemistry"**, Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015.
3. S. Vairam, P. Kalyani and Suba Ramesh, **"Engineering Chemistry"**, Wiley India PVT, LTD, New Delhi, 2013.

REFERENCE BOOKS:

1. Friedrich Emich, **"Engineering Chemistry"**, Scientific International PVT, LTD, New Delhi, 2014.
2. S.S. Dara and S.S. Umare, **"A Text Book of Engineering Chemistry"**, S. Chand & Company LTD, New Delhi, 2015.
3. B. Sivasankar, **"Engineering Chemistry"**, Tata McGraw-Hill Publishing

Company LTD, 2012

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1901005 PROBLEM SOLVING AND PYTHON PROGRAMING L T P C

(Common to all branches of B.E. / B.Tech. Programmes) **3 0 0 3**

OBJECTIVES:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures – lists, tuples, dictionaries.

UNIT- I: ALGORITHMIC PROBLEM SOLVING, DATA TYPES 9

Algorithms: building blocks of algorithms (statements, control flow, functions), notation (pseudo code, flow chart). Python interpreter and interactive mode; **values and types:** int, float, Boolean, string, and list; variables, operators and expressions, statements, tuple assignment, precedence of operators, comments, Illustrative programs: Algorithm for Arithmetic expression (addition and subtraction).

UNIT- II: CONTROL FLOW STATEMENTS AND FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); **Iteration:** state, while, for, break, continue, pass; functions, function definition and use. **Fruitful functions:** return values, parameters,

local and global scope, recursion. Illustrative programs: exchange the values of two variables square root, printing n numbers iteratively

UNIT-III: LIST& TUPLES **9**

Lists: list operations, list slices, list methods, list loop, mutability, list parameters; **Tuples:** tuple assignment, tuple as return value. Comparison of Lists and tuples. Illustrative programs: selection sort, insertion sort, Quick sort.

UNIT- IV: STRINGS, DICTIONARIES & SET **9**

Strings: string slices, immutability, string functions and methods, string module. **Dictionaries:** Operations (create, access, add, remove) and methods. (insert, delete).Set operation (Access, Add, Remove).Comparison of dictionary and set.

UNIT- V: FILES, MODULES & PACKAGES **9**

Files and exception: text files, reading and writing files, format operator; errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop algorithmic solutions to simple computational problems.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, Set and dictionaries.
- Read and write data from/to files in Python Programs.

TEXT BOOKS:

1. Reema Thareja, **“Python Programming using Problem solving Approach”** ,Oxford Higher Education,2017
2. Allen B. Downey, **“Think Python: How to Think Like a Computer Scientist”**, 2nd edition, Updated for Python 3, Shroff/O’Reilly Publishers,

2016 (http://greenteapress.com/wp/think-python/)

3. Guido van Rossum and Fred L. Drake Jr, **"An Introduction to Python**" – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCE BOOKS:

1. Charles Dierbach, **"Introduction to Computer Science using Python: A Computational Problem-Solving Focus**", Wiley India Edition, 2013.
2. John V Guttag, **"Introduction to Computation and Programming Using Python''**, Revised and expanded Edition, MIT Press , 2013
3. Kenneth A. Lambert, **"Fundamentals of Python: First Programs"**, CENGAGE Learning, 2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, **"Practical Programming: An Introduction to Computer Science using Python 3"**, Second edition, Pragmatic Programmers,LLC,2013.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, **"Introduction to Programming in Python: An Inter-disciplinary Approach"**, Pearson India Education Services Pvt. Ltd., 2016.

CO	PO												PSO			
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1901107	BASIC ELECTRICAL AND ELECTRONICS FOR AGRICULTURE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the basic concepts in Electrical circuits & Wiring.
- To explain the different components and function of electrical machines.
- To explain the fundamentals of semiconductor devices and applications.
- To explain the principles of digital electronics.
- To impart knowledge of working principle of various transducers and measuring instruments.

UNIT- I: ELECTRICAL CIRCUITS **9**

Fundamental laws of electric circuits – Steady State Solution of DC Circuits – Introduction to AC Circuits – Sinusoidal steady state analysis – Power and Power factor – Single Phase and Three Phase Balanced Circuits - Three phase loads - Materials of wiring, Housing wiring, Industrial wiring.

UNIT- II: ELECTRICAL MACHINES **9**

Construction - Principle of Operation - Basic Equations and Applications of DC Generators - DC Motors - Single & Three Phase Transformer - Single & Three Phase induction Motor – Synchronous Motor.

UNIT- III: SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

Introduction - Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics.

UNIT- IV: DIGITAL ELECTRONICS **9**

Binary Number System – Logic Gates - Boolean Algebra theorems – Digital circuits - Introduction to sequential Circuits – Flip-Flops – Registers and Counters – A/D and D/A Conversion.

UNIT- V: MEASUREMENTS & INSTRUMENTATION **9**

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, Piezoelectric, Photoelectric, Hall Effect and Mechanical. Classification of instruments - Types of indicating Instruments - Multimeters – Oscilloscopes - Three-phase power measurements – Instrument transformers (CT and PT).

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to identify and explain about electrical circuits and wiring.
- Ability to identify and explain the construction and working of electrical machines.
- Ability to identify electronic components and explain its characteristics.
- Ability to acquire knowledge on digital electronics.
- Ability to acquire knowledge on various transducers and measuring instruments.

TEXT BOOKS:

1. D.P. Kothari and I.J. Nagarath, **"Basic Electrical and Electronics Engineering"**, McGraw Hill Education (India) Private Limited, Third Reprint, 2016.
2. S.K. Bhattacharya, **"Basic Electrical and Electronics Engineering"**, Pearson India, 2011.
3. Sedha R.S., **"Applied Electronics"**, S. Chand & Co., 2008.
4. Thereja .B.L. **"Fundamentals of Electrical Engineering and Electronics"**, S.Chand & Co. Ltd., 2008.

REFERENCES:

1. A.E. Fitzgerald, David E Higginbotham and Arvin Grabel, **"Basic Electrical Engineering"**, McGraw Hill Education (India) Private Limited, 2009.
2. Del Toro, **"Electrical Engineering Fundamentals"**, Pearson Education, New Delhi, 2007.

3. Leonard S Bobrow, **"Foundations of Electrical Engineering"**, Oxford University Press, 2013.
4. 4Allan S Moris, **"Measurement and Instrumentation Principles"**, Elseveir, First Indian Edition, 2006.
5. John Bird, **"Electrical Circuit Theory and Technology"**, Elsevier, First Indian Edition, 2006.
6. Mehta V K, **"Principles of Electronics"**, S.Chand. & Company Ltd, 2008.
7. N K De, Dipu Sarkar, **"Basic Electrical Engineering"**, Universities Press (India) Private Limited, 2016.
8. Rajendra Prasad, **"Fundamentals of Electrical Engineering"**, Prentice Hall of India, 2014

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3	3	3	3	2	2	1			1			2				3
4	3	2	2	3	3	1			1			2	3			2
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1901108 **PHYSICS AND CHEMISTRY LABORATORY** **L T P C**

(Common to all branches of B.E. / B.Tech. Programmes) **0 0 4 2**

PHYSICS LABORATORY

OBJECTIVES:

- To study the behaviour of material under shear stress.
- To learn the basics concept understanding the deformation due to linear stress

- To explore the photons to measure the physical parameters.
- To introduce experiments to test thermal conductivity of bad conductor.
- To study the spectrum of white light.

LIST OF EXPERIMENTS: (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum.
2. Determination of Young's modulus by non-uniform bending method.
3. (a) Determination of wavelength and particle size using Laser.
   (b) Determination of acceptance angle and numerical aperture in an optical Fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid and Solid – Ultrasonic Interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Measure the rigidity modulus of the material.
- Calculate the deformation due to linear stress and Young's Modulus
- Use laser to measure the physical parameters.
- Calculate the thermal conductivity of bad conductor by lees disc.
- Measure the wavelength of the mercury the spectrum.

REFERENCE BOOKS:

1. Wilson J.D. and Hernaandez Hall C.A. – **"Physics Laboratory Experiments",** Houghton Mifflin Company, New York, 2005.
2. S. Srinivasan, **"A Text Book of Practical Physics",** S. Sultan Chand publications. 2005
3. R. Sasikumar, **"Practical Physics",** PHI Learning Pvt. Ltd, New Delhi, 2011.

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1	1	-	1	-	1	1	-	-	-	1	-	-	-
2	3	1	1	1	-	1	-	1	1	-	-	-	1	-	-	-
3	3	1	1	1	-	2	-	1	1	-	-	-	2	-	-	-
4	3	1	1	1	-	1	-	1	1	-	-	-	2	-	-	-
5	3	1	1	1	-	1	-	1	1	-	-	-	1	-	-	-

CHEMISTRY LABORATORY

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometery.
- To make the student conversant with the corrosion defects experimentally.
- To develop and understand the basic concepts of acidic and basic nature using pH.5
- To make the student familiar with the properties and nature of alloys experimentally

LIST OF EXPERIMENTS: (Any 5 Experiments)

1. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.
2. Estimation of copper content of the given solution by iodometry.
3. Determination of strength of given hydrochloric acid using pH meter.
4. Determination of strength of acids in a mixture of acids using conductivity meter.
5. Estimation of iron content of the given solution using potentiometer.
6. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.

7. Pseudo first order kinetics-ester hydrolysis.
8. Corrosion experiment-weight loss method.
9. Conductometric titration of strong acid Vs strong base.

TOTAL: 30 PERIODS

OUTCOMES:

- Obtain the hands-on knowledge in the quantitative chemical analysis of water quality related parameters.
- Understand the experimental concepts in the mixture of acids and bases.
- Appreciate the need of iodometry in the estimation of metals.
- Explore the drawbacks of corrosion by weight loss method.
- Design and carry out the scientific experiments related to boiler troubles.

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8th Edition, 2014)

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	1	2			2					1				
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.1901009 PROBLEM SOLVING PYTHON PROGRAMMING LABORATORY

L T P C

0 0 4 2

OBJECTIVES:

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

LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. How to create, slice, change, delete and index elements using Tuple.
8. Find First n prime numbers
9. How to create, slice, change, add, delete and index elements using list.
10. Write a program to calculate the length of a string.
11. Write a program to reverse the string
12. How to change, delete, add and remove elements in Dictionary
13. Find the most frequent words in a text read from a file
14. Simulate elliptical orbits in Pygame
15. Simulate bouncing ball using Pygame

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

TOTAL: 60 PERIODS

OUTCOMES:

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

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

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SEMESTER II

1919201 **TECHNICAL ENGLISH** **L T P C**

(Common to all branches of B.E. / B.Tech. Programmes) **3 0 0 3**

OBJECTIVES:

The Course prepares second semester Engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Participate in group discussions.

- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT- I: INTRODUCTION **9**

Listening– Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newspapers- **Writing**– purpose statements – Technical Jargons, homophones – writing instructions – checklists-recommendations- **Vocabulary Development**– technical vocabulary **Language Development** –subject verb agreement – compound words.

UNIT- II : READING AND STUDY SKILLS **9**

Listening– Listening to a technical conversation and filling the gaps-**Speaking** – describing a process-**Reading** – reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing**– interpreting charts, graphs- **Vocabulary Development-**vocabulary used in formal letters/emails and reports **Language Development-** impersonal passive voice, numerical adjectives.

UNIT- III:TECHNICAL WRITING AND GRAMMER **9**

Listening– Listening to classroom lectures/ talks on engineering/technology – **Speaking** – mechanics of presentations - **Reading** – longer texts both general and technical, practice in speed reading; **Writing**-Describing a process, use of sequence words- **Vocabulary Development-** Misspelt words. **Language Development-** homonyms

UNIT- IV : REPORT WRITING **9**

Listening– Listening to documentaries and making notes. **Speaking** – introduction to technical presentations - **Reading** – reading for detailed comprehension- **Writing**– Product description - job application – cover letter –Résumé preparation(via email and hard copy)- Issue based essays and official circulars– **Vocabulary Development**– finding suitable synonyms-paraphrasing-. **Language Development-** clauses- if conditionals.

UNIT –V: GROUP DISCUSSION AND JOB APPLICATIONS **9**

Listening– TED/INK talks, answering the questions; **Speaking** –participating in a group discussion –**Reading**– reading and understanding technical articles **Writing**– Writing reports- minutes of a meeting- Letter Writing- Letter to the Editor – Letter seeking permission for an Industrial visit/ Internship –Business Letters, asking for quotation/clarifications - seeking orders , thanking for the orders given, Complaint letters - **Vocabulary Development-** verbal analogies **Language Development-** reported speech.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course learners will be able to:

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialization successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Participate in group discussions.
- Write reports and winning job applications.

TEXT BOOKS:

1. Board of editors. **Fluency in English A Course book for Engineering and Technology.** Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. **English for Technical Communication**. Cambridge University Press: New Delhi, 2016

REFERENCE BOOKS:

1. Raman, Meenakshi and Sharma, Sangeetha- **Technical Communication Principles and Practice.** Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. **Engineering English**. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana**, Project Work,** Oxford University Press**,** Oxford: 2014.
4. Grussendorf, Marion, **English for Presentations,** Oxford University Press, Oxford: 2007

5. Means, L. Thomas and Elaine Langlois, **English & Communication For Colleges.**

6. IELTS - Cambridge University Press

7. BEC - Cambridge University Press

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	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
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2	3	2	2	-	-	-	-	-	-	-	-	2	1	1	1	1
3	3	-	-	-	-	-	-	-	3	3	-	1	1	1	1	1
4	3	2	2	2	-	-	-	-	-	3	-	1	1	2	1	1
5	3	2	-	2	-	-	-	-	-	3	2	1	2	2	1	1

1918202 **ENGINEERING MATHEMATICS – II** **L T P C**

3 1 0 4

OBJECTIVES:

- This course is designed to cover topics such as Ordinary Differential equation, Vector Calculus, Complex Analysis and Laplace Transform.
- ODE is the powerful tools to solve practical problems in the field of engineering.
- Vector calculus can be widely used for modeling the various laws of physics.
- The various methods of complex analysis helps us to evaluate contour integration.
- Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering.

UNIT-I: ORDINARY DIFFERENTIAL EQUATIONS **9L+3T**

First order linear Differential equations- Exact differential equations- Second order linear differential equations with constant coefficients – Method of variation of parameters – Homogenous equation of Euler's and Legendre's type.

UNIT-II: VECTOR CALCULUS **9L+3T**

Gradient and directional derivative – Divergence and curl– Irrotational and Solenoidal vector fields – Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT-III: LAPLACE TRANSFORMS **9L+3T**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients

UNIT-IV: ANALYTIC FUNCTIONS **9L+3T**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian coordinates – Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions $w = Cz, C + z, \frac{1}{z}, z^2$ Bilinear transformation

UNIT-V: COMPLEX INTEGRATION **9L+3T**

Complex integration – Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour

TOTAL: 45L+15T PERIODS

OUTCOMES:

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

- Apply complex variables in finding ,Gradient, divergence,curl of a vector point function.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration are evaluated.
- Laplace transform and inverse transform of simple functions, properties, are

- studied.

- Apply various techniques in solving Ordinary differential equations with constant coefficients

TEXT BOOKS:

1. Grewal. B.S, **"Higher Engineering Mathematics",** Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Veerarajan. T, **"Engineering Mathematics"**, McGraw Hill Education (India) Private Limited, 2019.

REFERENCE BOOKS:

1. Kreyszig Erwin, **"Advanced Engineering Mathematics"**, John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Jain R.K. and Iyengar S.R.K., **"Advanced Engineering Mathematics"**, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O'Neil, P.V. **"Advanced Engineering Mathematics"**, Cengage Learning India Pvt., Ltd, New Delhi, 2007.

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3	3	1	2	1	-	-	-		-	-	-	1	-	-	-	-
4	3	2	1	-	-	-	-		-	-	-	1	-	-	-	-
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1920205 PHYSICS FOR AGRICULTURE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge about the mechanism governing the behaviour of soil and its role in the biosphere for its proper management.
- To study the physical processes for transport of water and nutrients in soil.

- Know the operating principle and the use of different measuring instrument in different sector.
- Understanding basic characteristics of renewable sources of energy and technologies for their utilisation.
- Learn regarding Biodiversity and its conservation, natural disaster and manmade disaster along with their management.

UNIT- I: BASICS OF SOIL PHYSICS **9**

Basic principles of physics applied to soils viz. viscosity, surface tension, capillarity, stress-strain relations, gaseous diffusion, heat transport, thermodynamic principles; Properties of water in relation to porous media.Flow of water in soil; Darcy's law, hydraulic conductivity and water diffusivity; saturated and unsaturated flow and equations; Methods for saturated and unsaturated hydraulic conductivity measurement- both *in situ* and in laboratory; Capillary movement of water, contact angle.

UNIT- II: INTRODUCTION TO ENERGY HARVESTING **9**

Energy sources, Introduction, Classification, Energy from Biomass, Types of biogas plants, constructional details, Principles of combustion, pyrolysis and gasification, Types of gasifiers, Briquetting , Types of Briquetting machines, Wind energy, Types of wind mills, Constructional details and application of wind mills; Modern applications and future potential of renewable energy sources.

UNIT- III: PHYSICS OF ARTIFICIAL FARMING **9**

Introduction – Planting techniques: Vertical farming- Hydroponics-Indoor farming. Plant Environment interactions-principles of limiting factors: Solar radiation and transpiration – green house effect, light, temperature, Relative Humidity.Solar energy applications : Solar flat plate and focusing plate collectors, solar grain dryers, Solar Refrigeration system, Solar ponds, solar fencing, Solar pumping systems.

UNIT- IV: MEASUREMENT TECHNIQUES **9**

Sensors and transducers, principles of operation of field-based instruments like leaf area meter, canopy analyzer, quantum sensor, spectroradiometer, laser land leveller

etc., infrared thermometry, principles, emissivity, infrared spectroscopy, characteristics of agricultural materials.

UNIT- V: DISASTER HAZARDS AND VULNERABILITIES IN AGRICULTURE 9

Natural disasters- meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves, climatic change: global warming, Man-made disasters- nuclear disasters, chemical disasters, biological disasters, forest fire, air pollution, water pollution, deforestation, industrial waste water pollution.

Disaster management- effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; role of NGOs, community – based organizations and media.

TOTAL: 45 PERIODS

OUTCOMES:

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

- The students will have knowledge of basic properties of soil, analysis of stresses, bearing capacity of soil etc.
- The student will incline towards conservation of energy through application of efficient devices and practices
- To promote best practices for recourse/energy management in various sectors.
- The students will gain knowledge on the usage of modern machinery and technology in agriculture.
- The students will understand the natural hazards and disaster management.

TEXT BOOKS:

1. **“Hand book of Solar Energy”**, G.N. Tiwari, Aravind Divari, Shyam, Springer Publications.
2. **“Principles of Soil Physics”**, Rattan Lal Manoj K .Shukla, New York: Marcel Dekker; London: Taylor & Francis, 2004.

3. **"Environment Problems and Solution"**, D. K. Asthana and M. Asthana ,Schand Publications.
4. **"Ecology and Environment"**, P.D. Sharma Rastogi Publications , 2012.
5. **"Agricultural Physics"**, Vikas Singh, Vikas Publications.
6. **"Precision Farming",** Sharma P, Daya Publishing House New Delhi, 2007.

REFERENCE BOOKS:

1. **"Non-Conventional Energy Sources"**, Rai, G.D. Khanna Publishers, New Delhi, 2013.
2. **"Physics of Solar Energy",** C. Julian Chen, John Wiley & Sons, Inc. 2011.
3. **"Wind and Solar Power Systems"**, Mukund R. Patel , CRC Press .
4. **"Non-Conventional Energy Resources"**, B. H. Khan, The McGraw Hill Publishers.
5. **"Principles of Agricultural Engineering"**, Michael, A.M. and T.P. Ojha. Volume II. 4th Edition, Jain Brothers, New Delhi, 2003.
6. **"Soil Physics"**, Jury, W.A., Gardner, W. and Horton, R., John Wiley and Sons, New York, 2004.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	3	-	1	2	-	-	-	-	-	2	2	2	3	3
2	3	1	3	2	3	2	2	-	3	-	-	2	3	3	3	3
3	3	2	2	3	3	3	2	-	3	-	2	2	3	3	3	3
4	3	1	2	3	2	3	2	-	2	-	1	3	3	3	3	3
5	3	1	1	1	1	2	3	1	1	-	2	3	3	2	3	2

1921203 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C

(Common to all branches of B.E. / B.Tech. Programmes) **3 0 0 3**

OBJECTIVES:

- To study the nature and facts about environment.

- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT-I: ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the grassland ecosystem, aquatic ecosystems (lakes, oceans)
– Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of an ecosystems.

UNIT-II: ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local

polluted site – Urban / Rural / Industrial /Agricultural.

UNIT-III: NATURAL RESOURCES **10**

Forest resources: Use and over-exploitation, deforestation, soil erosion and desertification, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water– Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity– role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT-IV: SOCIAL ISSUES AND THE ENVIRONMENT **7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting and watershed management – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation Act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT-V: HUMAN POPULATION AND THE ENVIRONMENT **6**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to

- Gain knowledge on ecosystem, environment and biodiversity.
- Understand the process and disadvantages of environmental pollution.
- Analyze the ill effects of over exploitation of natural resources.
- Explain the social issues from unsustainable to sustainable development.
- Outline the need for decrease in population growth and its measures.

TEXT BOOKS:

1. Benny Joseph, **"Environmental Science and Engineering"**, Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M. Masters, **"Introduction to Environmental Engineering and Science"**, 2nd Edition, Pearson Education, 2004.

REFERENCE BOOKS:

1. Dharmendra S. Sengar, **"Environmental law"**, Prentice Hall of India PVT LTD, New Delhi, 2007.
2. Erach Bharucha, **"Textbook of Environmental Studies"**, Universities Press (I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, **"Environmental Studies - From Crisis to Cure"**, Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, **"Environmental Science"**, Cengage Learning India PVT, LTD, Delhi, 2014.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1				1	2		2			1	1	1	1	1
2	2	2	3			2	3		1			3	1	3	3	2
3	2	1	2			2	3		2			3	1	1	1	1
4	1	3	2				3		3			2	2	3	3	1
5	1	1	1			1	2					1	1	1	1	1

1901006 **PROGRAMMING IN C** **L T P C**

3 0 0 3

OBJECTIVES:

- To develop C Programs using basic programming.
- To develop C programs using arrays
- To develop C programs using strings.
- To develop applications in C using functions
- To develop C program using structures and union

UNIT-I: BASICS OF C PROGRAMMING **9**

Introduction to algorithm: Flowchart-Pseudo code- Introduction to programming paradigms- C programming: Data Types -Keywords-Variables and Constants– Operators and Expressions: Expressions -precedence,-associativity-Input/Output statements-Decision making and looping: Branching statement, Iterative statement - Compilation process.

UNIT-II: ARRAYS AND STRINGS **9**

Introduction to Arrays: One dimensional array: Assigning an array to another array – Equating an array with another array-Two dimensional Arrays: Declaration-usage of two dimensional array-reading, storing and accessing elements in two dimensional array-memory representation-String operations: String library functions- list of strings-command line arguments.

UNIT-III: FUNCTIONS **9**

Introduction to functions: Classification of functions- function definition-function call-function with inputs and outputs-recursive function-library functions-scope of variables.

UNIT-IV: STRUCTURES AND UNIONS **9**

Introduction to Structures: Array of structures – Nested structure-functions and Structures-Introduction to union-: practical applications of union —typedef and structures-enumerated data type.

UNIT-V: STORAGE CLASS AND PREPROCESSOR DIRECTIVE **9**

Introduction to storage classes: Types of storage classes- C preprocessor Directives: Types of preprocessor directives-Pragma Directive-conditional directive.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Develop simple applications in C using basic constructs.
- Design and implement applications using arrays and strings
- Develop and implement applications in C using functions
- Develop applications in C using structures and unions
- Design applications using preprocessor to stimulate functions

TEXT BOOKS:

1. Anita Goel and Ajay Mittal, —Computer Fundamentals and Programming in C, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. ReemaThareja, —Programming in C, Oxford University Press, Second Edition, 2016.

REFERENCE BOOKS:

1. Paul Deitel and Harvey Deitel, —C How to Program, Seventh edition, Pearson Publication.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3		3		2							1		2		
2	3	3			2		1						3			
3	2	1		2	3										2	
4			2						2		1			1		
5		3				1			2							3

1901007	ENGINEERING GRAPHICS	L	T	P	C
	(Common to all branches of B.E. / B.Tech. Programmes)	2	0	4	4

OBJECTIVES:

The main learning objective of this course is to impart knowledge

- To draw the conics curves and special curves.
- To draw the orthographic projection of lines and plane surfaces.
- To draw the projections and solids and Isometric projection of simple solids.
- To draw projections of Section of Solids and development of surfaces.
- To draw free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination) 1

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

UNIT-I: PLANE CURVES AND SPECIAL CURVES 10

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid (Rolling Circle rolls on flat surface only). Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

UNIT-II: PROJECTION OF POINTS, LINES AND PLANE SURFACES 16

Orthographic projection- Principles-Principal planes - First angle projection-projection of points at First Quadrant only. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) which inclined to both the principal planes by rotating object method.

UNIT-III: PROJECTION OF SOLIDS AND ISOMETRIC PROJECTION 16

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is Inclined to one of the principal planes by rotating object method. Principles of isometric projection – isometric scale – Isometric projections of simple solids - Prisms, pyramids, cylinders, cones.

UNIT-IV: PROJECTION OF SECTIONED SOLIDS & DEVELOPMENT OF SURFACES **16**

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

UNIT-V: FREE HAND SKETCHING AND PERSPECTIVE PROJECTIONS **16**

Free Hand sketching: Visualization principles – Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects. Perspective projection of simple solids-Prisms and pyramids by visual ray method.

TOTAL: 75 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- To draw the conics curves and special curves.
- To draw the orthographic projection of lines and plane surfaces.
- To draw the projections and solids and Isometric projection of simple solids.
- To draw projections of Section of Solids and development of surfaces.
- To draw free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids.

TEXT BOOKS:

1. N.D.BHATT, “**Engineering Drawing (Plane and Solid Geometry)”**, Charotar Publishing House PVT. LTD. 53rd Edition : 2018 (Reprint)
2. Venugopal K. and Prabhu Raja V., **“Engineering Graphics”**, New Age

International (P) Limited, 2018.

REFERENCE BOOKS:

1. T. Jeyapoovan, **"Engineering Graphics Using Auto CAD"**, Vikas Publishing House Pvt. LTD, seventh Edition, 2015.
2. Luzzader, Warren.J. and Duff, John M., **"Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production"**, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., **"Engineering Drawing"**, Pearson, 2nd Edition, 2011.
4. Natrajan K.V., **"A text book of Engineering Graphics"**, Dhanalakshmi Publishers, Chennai, 2009.
5. Basant Agarwal and Agarwal C.M., **"Engineering Drawing"**, Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students

will be permitted to use appropriate scale to fit solution within A3 size.

4. The examination will be conducted in appropriate sessions on the same day.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1
2	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1
3	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1
4	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1
5	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1

1901010 C PROGRAMMING LABORATORY L T P C

0 0 4 2

OBJECTIVES:

- To develop programs in C using basic constructs.
- To develop applications in C using arrays and functions.
- To develop applications in C using Strings and Structures.
- To develop various applications using array concepts
- To develop various application using function concept.

LIST OF PROGRAMS:

1. Programs using I/O statements and expressions.
2. Programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Check whether a given number is Armstrong number or not?
6. Check whether a given number is odd or even?
7. Write a program to perform factorial of a number.
8. Write a C program to find out the average of 4 integers.

9. Show how to display array elements using two dimensional array.
10. Write a C program to perform swapping using function.
11. Display all prime numbers between two intervals using functions.
12. Reverse a sentence using recursion.
13. Write a program in C to get the largest element of an array using the function.
14. Write a C program to concatenate two string.
15. Write a C program to find the length of String.
16. Find the frequency of a character in a string.
17. Write a C program to Store Student Information in Structure and Display it.
18. The annual examination is conducted for 10 students for five subjects. Write a program to read the data and determine the following:

(a) Total marks obtained by each student.

(b) The highest marks in each subject and the marks of the student who secured it.

(c) The student who obtained the highest total marks.

TOTAL : 60 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Develop C programs for simple applications.
- Making use of basic constructs, arrays and strings.
- Develop C programs involving functions,
- Develop program using recursion, pointers, and structures.
- Design applications using sequential and random access file processing.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3		3										2			
2					2					1					2	
3				2					1							2
4		2				2					2			2		
5								3				1	2			

1901208	ENGINEERING PRACTICES LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B.Tech. Programmes)	0	0	4	2

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
- To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools
- To gain the skills for making fitting joints and assembling air conditioner
- To develop the skills for making simple electrical wiring connections using suitable tools
- To provide hands on experience for soldering and gain knowledge about the behavior of electronics components

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 15

Buildings:

a) Study of plumbing and carpentry components of residential and industrial buildings safety aspects.

Plumbing Works:

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
b) Study of pipe connections requirements for pumps and turbines.
c) Preparation of plumbing line sketches for water supply and sewage works.
d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry Works:

a) Study of the joints in roofs, doors, windows and furniture.

b) Hands-on-exercise:

Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 15

Welding:

a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.

b) Gas welding practice

Basic Machining:

a) Simple Turning and Taper turning

b) Drilling Practice

Sheet Metal Work:

a) Forming & Bending

b) Model making – Trays and funnels.

c) Different type of joints.

Fitting:

a) Preparation of square fitting

b) Preparation of V – fitting models.

Machine assembly practice:

a) Assembly of centrifugal pump

b) Assembly of air conditioner

Demonstration on:

a) Smithy operations, upsetting, swaging, setting down and bending.

Example – Exercise – Production of hexagonal headed bolt.

b) Foundry operations like mould preparation for gear and step cone pulley.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 15

1. Residential house wiring using Switches, Fuse, Indicator, Lamp and Energy meter.
2. Fluorescent Lamp Wiring.
3. Staircase Wiring.
4. Measurement of Voltage, Current, Power and Power factor in electrical circuit.
5. Measurement of Energy using Analog & Digital Energy meter.
6. Measurement of Earth Resistance.
7. Study of Industrial house wiring.
8. Identification & Study of protective devices: Fuses & Fuse carriers, MCB, ELCB and Isolators with ratings and usage.

IV ELECTRONICS ENGINEERING PRACTICE 15

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- Fabricate carpentry components and pipe connections including plumbing works.
- Use welding equipments to join the structures.
- Carry out the basic machining operations

- Make the models using sheet metalwork’s
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS: CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets
2. Carpentry vice (fitted to work bench) 15 Nos.
3. Standard woodworking tools 15 Sets
4. Models of industrial trusses, door joints, furniture joints 5 each

MECHANICAL

1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer, Wire brush, etc. 5 Sets
4. Oxygen and acetylene gas cylinders, blow pipe and other Welding outfit. 2 Nos.
5. Centre lathe 2 Nos.
6. Hearth furnace, anvil and smithy tools 2 Sets
7. Moulding table, foundry tools 2 Sets
8. Power Tool: Angle Grinder 2 Nos.
9. Study-purpose items: centrifugal pump, air-conditioner One each
10. Fitting tools, Hack saw frame, 12' file, hack saw blade 15 Nos.

ELECTRICAL

1.	Assorted electrical components for house wiring	15 Sets
2.	Fluorescent Lamp	15 Sets
3.	Electrical measuring instruments	10 Sets
4.	Analog & Digital energy meter	5 Sets
5.	Megger	2

ELECTRONICS

1.	Soldering guns	10 Nos.
2.	Assorted electronic components for making circuits	50 Nos.
3.	Small PCBs	10 Nos.
4.	Multimeters	10 Nos.
5.	Study purpose items: Telephone, FM radio, low-voltage power supply	

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3					1						1	3			
2		1	2		3						1			1	2	
3				3	2							1				3
4		2	3	1	2									2	3	1
5		3	2	2					1					3	2	2

1901209	APPLIED PHYSICS AND ENVIRONMENTAL CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

(Common to all branches of B.E. / B.Tech. Programmes)

(Laboratory classes on alternate weeks for Physics and Environmental Chemistry)

APPLIED PHYSICS LABORATORY

OBJECTIVES:

- To measure the band gap of given semi conductor.
- To study I-V characteristics of solar cell
- To measure electrical resistivity of metal and alloy
- To calculate the hkl planes
- To measure the paramagnetic susceptibility by Quinke's method

LIST OF EXPERIMENTS: (Any 5 Experiments)

1. Determination of band gap of a semiconductor.
2. Study of I-V characteristics of solar cell and determination of its efficiency.
3. Determination of electrical resistivity of metal and alloy –Carey foster Bridge.
4. Calculation of lattice cell parameter – X-ray diffraction method.
5. Measurement of susceptibility of paramagnetic solution by Quinke's method.
6. Study of magnetic Hysteresis-B-H curve.
7. Measurement of Temperature using LM35.

TOTAL: 30 PERIODS

DEMO:

1. Crystal growth- Low temperature solution growth.
2. Absorption and transmittance measurement of materials – UV visible spectrum.
3. Attenuation losses in optical Fiber.

OUTCOMES:

Upon completion of the course, the students will be able to

1. Measure the band gap of semiconductors
2. Measure the efficiency of solar cell
3. Compare the resistivity of metals and alloys

4. Calculate the lattice parameter and interplanar distance.
5. Understand the susceptibility values for any paramagnetic substances

REFERENCE BOOKS:

4. Wilson J.D. and Hernaandez Hall C.A. – **"Physics Laboratory Experiments",** Houghton Mifflin Company, New York, 2005.
5. S. Srinivasan, **"A Text Book of Practical Physics",** S. Sultan Chand publications. 2005.
6. R. Sasikumar, **"Practical Physics",** PHI Learning Pvt. Ltd, New Delhi, 2011.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	2	2	-	1	-	1	1	-	-	-	2	-	-	-
2	3	2	2	2	-	1	-	1	1	-	-	-	2	-	-	-
3	3	2	2	1	-	-	-	1	1	-	-	-	3	-	-	-
4	3	1	2	2	-	1	-	1	1	-	-	-	1	-	-	-
5	3	2	2	2	-	2	-	1	1	-	-	-	2	-	-	-

ENVIRONMENTAL CHEMISTRY LABORATORY

OBJECTIVES:

- To determine the dissolved oxygen and chloride content in water
- To determine calcium and magnesium present in domestic water
- To estimate iron, sodium and chlorine using various techniques
- To determine the chemical oxygen demand in industrial effluent
- To determine the available chlorine in bleaching powder.

LIST OF EXPERIMENTS: (Any 5 Experiments)

1. Determination of total, temporary & permanent hardness of water by EDTA

method.

2. Determination of DO content of water sample by Winkler's method.
3. Determination of chloride content of water sample by argentometric method.
4. Estimation of iron content of the water sample using spectrophotometer
5. Determination of COD value of industrial effluents
6. Estimation of sodium by flame photometry
7. Estimation of available chlorine in bleaching powder

TOTAL: 30 PERIODS

DEMO:

1. Pollution abatement by adsorption techniques
2. Scintillation Process

OUTCOMES:

- Appreciate the basic requirements for potable water.
- Understand the need of dissolved oxygen in water.
- Explore the quantity of bleaching powder to be added in water.
- Analyze the ill effects caused by the industrial effluents.
- Explore new research areas in the treatment of waste water

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8th Edition, 2014)

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3		3	3					1				
2	3	3	2	3		3	3					1				
3	3	3	3	3		2	3					1				
4	2	3	3	2		3	3					2	2	3	2	1
5	3	3	3	3		3	3					1				

1901200 NSS/NCC/YRC/NSO

UNIT – I : NATIONAL SERVICE SCHEME (NSS) **L T P C**

0 0 2 1

OBJECTIVES:

The main objectives of this course are:

- To help learners know about NSS in the context of youth, community and voluntary service.
- To teach the importance of health, hygiene and sanitation for a healthy Nation.
- To understand the community in which they work.
- To identify the problems of the community and involve them in problem-solving.
- To develop the capacity to meet emergencies and natural disasters.
- To practice the National integration and social harmony.
- To utilize their knowledge in finding practical solutions to individual and community

MODULE -I : INTRODUCTION AND BASIC CONCEPTS OF NSS 8

History – Aim – Objectives of NSS- Emblem – Motto – Badge –Song- Organizational structure - Roles and Responsibilities of NSS-Regular activities - Any approved indoor / outdoor programs approved by the Principal

MODULE-II :YOUTH LEADERSHIP, SOCIAL HARMONY AND NATIONAL INTEGRATION 8

Meaning and types of Leadership - Qualities of good leaders and leadership - Importance and role of youth leadership - Role of youth in peace and Nation building - Any approved indoor / outdoor programs approved by the Principal

MODULE -III : HEALTH, HYGIENE AND SANITATION AND YOUTH HEALTH 8

Definition, Needs and Scope of Health Education - Swachh Bharat Abhiyan - Healthy Lifestyles HIV, AIDS, Drugs abuse - Any approved indoor / outdoor programs approved by the Principal

MODULE-IV :ENVIRONMENT ISSUES, EMERGENCIES AND DISASTER MANAGEMENT 8

Environment conservation, enrichment and sustainability - Waste management - Natural resource management [Rain water harvesting and Energy

conservation] - Introduction to Disaster Management, Classification of Disasters - Any approved indoor / outdoor programs approved by the Principal

MODULE-V: SPECIAL CAMPING AND YOUTH DEVELOPMENT PROGRAMMES 8

Aim and objectives of special camping - Organization of special camping - National Youth Policy - Youth Development - Any approved indoor / outdoor programs approved by the Principal

TOTAL: 40 PERIODS

OUTCOMES:

- Learners will have the knowledge about NSS and its role in the fields of health, hygiene, emergencies & natural disasters and involve them in problem-solving of the nearest community so as to build a strong country.

REFERENCE BOOKS:

1. National Service Scheme Manual (Revised) 2006, Government of India, Ministry ofYouth Affairs and Sports, New Delhi.
2. National Youth Policy, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
3. https://nss.gov.in/
4. National Service Scheme Handbook, Anna University, Chennai - 25.

UNIT – II : NATIONAL CADETS CORPS **L T P C**

0 0 2 1

OBJECTIVES:

- To develop the students character into comradeship
- To improve the self-responsibilities of the student
- To give the secular outlook
- To perform the adventure activates
- To give the ideas of selfless service among young citizens

MODULE -I : INTRODUCTION NCC 8

Moto of NCC- Cardinal principals of Discipline - Aim of NCC – History of NCC – NCC Organization- NCC Song - Opportunities in Indian Army

MODULE -II : BASIC DRILL PRACTICE **8**

Foot Drill – Arms Drill – Ceremonial Drill – Attention – Right Face – Salute – Present Arms and Orders – Forward March.

MODULE -III : NCC ARMY **8**

Armed Forces – Military History – Badges and Ranks- Setting a Map, Finding Own Position and North– General Awareness – Border & Coastal Areas

MODULE -IV : NCC NAVY **8**

History of Indian Navy – Types of Warship and Roles – Navy Ranks – Role of INDO PAK war – 1971 &Kargil war – Naval Communications

MODULE -V : NCC SAFETY AND RESCUE OPERATIONS **8**

First Aid – Firefighting – Flooding – Damage Control - Health and Hygiene – Swimming - Trekking

TOTAL: 40 PERIODS

OUTCOMES:

- The NCC cadets learnt several Valuable things Selfness, Honesty Hard work and discipline
- NCC develops their personalities in different angles
- NCC army grows the turnout cadets in Army
- NCC Navy intensification the technical information about the coastal areas
- NCC generally improve the personal and social impact
- NCC is foot path to join in an Indian defense

TEXT BOOKS:

1. R Gupta's "NCC Navy wing" it covers both Common and Special Subjects
2. R Gupta's "Handbook of National Cadets Corps for 'A', 'B' and 'C' certificate examination"
3. NCC Army Hand book https://nccorissa.org/old/Doc/cadet%20Hand%20Book%20SPL%20SUBJECT%20 Army.pdf

4. NCC Navy Hand Book https://dokumen.tips/documents/ncc-cadet-handbook-navy-specialised-subject-sd-swpdf-ncc-cadet-handbook.html

UNIT – III : YOUTH RED CROSS (YRC) **L T P C**

0 0 2 1

OBJECTIVES:

To inculcate the following in the youth of our college

- Health awareness
- Civic responsibilities with humanitarian concern
- Spirit of service
- Sense of duty
- Friendly relationship without discrimination

MODULE-I : INTRODUCTION **8**

Origin-Fundamental Principles-Humanity, Impartiality, Neutrality, Independence, Voluntary service, Unity, Universality based activities like First Aid etc.

MODULE-II : MOTTO **8**

Health-Protection of health and life , Service- Serving the sick and suffering,

Friendship- Promoting it through program like Financial Literacy etc.

MODULE- III :FEATURES OF YRC **8**

Organizing Committee-Structure-How to start a Unit- Core focus areas-Strategic Goals and Objectives through programs like Eye, Dental, General Health checkup etc.

MODULE-IV: REGULAR ACTIVITIES **8**

Disaster Relief- Health and Medical Service-Training Courses-Human resource development through programs on the above areas

MODULE-V: HUMANITARIAN PRINCIPLES **8**

Principle of Humanity-Principle of Distinction-Principle of Military Necessity-Principle of prevention of unnecessary suffering-Principle of Proportionality - programs on the above

TOTAL: 40 PERIODS

OUTCOMES:

The students would have got their **personality developed** through

- Health awareness
- Civic responsibilities with humanitarian concern
- Spirit of service
- Sense of duty
- Friendly relationship without discrimination

REFERENCE BOOKS:

1. IRCS/YRC Handbook
2. https://www.indianredcross.org/youth/Guidelines-for-JYRC-LR.pdf

UNIT- IV: NATIONALSPORTS ORGANISATION (NSO) **L T P C**

0 0 2 1

OBJECTIVES:

- To create awareness about basic fitness and mental strength
- To promote the development of physical fitness
- To develop the sporting activities of the youth
- To create the social responsibility and social interaction through participation

MODULE-I : **8**

Introduction of Physical Education- History - Origin - Physical Fitness Test- Major games Skills Test.

MODULE-II : **8**

Importance of Basic Physical Fitness - BMI Calculation - Identification of deformities - Nutrition & Diet for fitness - Major games practice.

MODULE- III **8**

Health Education - Physical Fitness Activities (Speed - Strength Endurance - Agility)minor games practice.

MODULE-IV: **8**

Major games introduction(Athletics - Badminton - Ball Badminton- Basketball- Chess- Cricket -Football -Kabaddi -Kho-Kho -Table Tennis -Volleyball) and tournament.

MODULE-V: **8**

Major games skills training - Physical Fitness Activities (50mtr dash-800mtr run-sit ups/pushups - shuttle run) Assessments.

TOTAL: 40 PERIODS

OUTCOMES:

- Get basic knowledge about physical and mental fitness and gain physical fitness and mental fitness
- NSO create-esteem and self confidence
- NSO provide opportunity get social interaction
- Development of character and personality through participation

SEMESTER III

1918301 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C

3 1 0 4

OBJECTIVES:

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations.
- Apply PDE in solving one dimensional Wave and Heat flow equations.
- To model several physical problems to develop Z transform techniques for discrete time systems.

UNIT-I: PARTIAL DIFFERENTIAL EQUATIONS 9L+3T

Formation of partial differential equations - Solutions Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT-II: FOURIER SERIES 9L+3T

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic analysis.

UNIT-III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9L+3T

Classification of PDE – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction in infinite plates(excluding insulated edges).

UNIT-IV: FOURIER TRANSFORMS 9L+3T

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT-V: Z – TRANSFORMS AND DIFFERENCE EQUATIONS 9L+3T

Z- transforms – Elementary properties – Inverse Z – transform (using partial fraction and residues) – Convolution theorem – Solution of difference equations using Z – transform.

TOTAL: 45L +15T PERIODS

OUTCOMES:

- Understand the fundamental concept of the concepts of Partial differential Equations.
- Understand the basic concepts of mathematical principles on Fourier & Z-transforms.
- Apply the concept of PDE and Solve Wave equation, and Heat flow equations.
- Understand the concept Fourier series and apply the concept in solving PDE.
- Understand the fundamental concept of the concepts of Solution of difference equations

TEXT BOOKS:

1. Veerarajan. T., “Transforms and Partial Differential Equations”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., “Higher Engineering Mathematics”, 42nd Edition, Khanna Publishers,
   Delhi, 2012.
3. Narayanan.S., ManicavachagomPillay.T.K and Ramanaiah.G “Advanced Mathematics for Engineering Students” Vol. II & III, S. Viswanathan Publishers Pvt. Ltd.1998.

REFERENCE BOOKS:

1. Bali.N.P and Manish Goyal, “A Textbook of Engineering Mathematics”, 7th Edition,
   Laxmi Publications Pvt Ltd, 2007.
2. Ramana.B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company Limited, NewDelhi, 2008.
3. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson

Education, 2007.

4. Erwin Kreyszig,“Advanced Engineering Mathematics”, 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, “Advanced Engineering Mathematics” Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. P.Sivaramakrishna Das, C.Vijayakumari, Transforms and Partial Differential Equations, Pearson India Education Services Pvt. Ltd, 2019.

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No Correlation - Low 1 Medium 2 High 3

1902301 SOIL SCIENCE AND ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To expose students to the fundamental knowledge on Soil physical parameters, Permeability.
- To introduce students about the soil survey and classification.
- To introduce students about soil phase relations, atterberg limits and indices.
- To expose students to the engineering properties of soil.
- To gain knowledge on Compaction, Bearing Capacity and types and methods of soil survey.

UNIT-I: INTRODUCTION AND SOIL PHYSICS **9**

Soil - definition - major components – Soil forming minerals and processes - soil profile - Physical properties - texture – density – porosity – consistence – colour - specific gravity - capillary and non - capillary – plasticity - Soil air - soil temperature - soil water - classification of soil water - Movement soil water - Soil colloids – organic and inorganic matter - Ion exchange- pH – Plant nutrient availability.

UNIT-II: SOIL CLASSIFICATION AND SURVEY **9**

Soil taxonomy – Soils of Tamil Nadu and India. Soil survey - types and methods of soil survey – Field mapping- mapping units - base maps -preparation of survey reports - concepts and uses - land capability classes and subclasses - soil suitability - Problem soils – Reclamation.

UNIT-III: PHASE RELATIONSHIP AND SOIL COMPACTION **9**

Phase relations- Gradation analysis- Atterberg Limits and Indices- Engineering Classification of soil – Soil compaction- factors affecting compaction- field and laboratory methods.

UNIT-IV: ENGINEERING PROPERTIES OF SOIL **9**

Shear strength of cohesive and cohesionless - Mohr-Coulomb failure theory- Measurement of shear strength, direct shear, Triaxial and vane shear test - Permeability- Coefficient of Permeability-Darcy's law-field and lab methods - Assessment of seepage – Compressibility – Liquefaction.

UNIT-V: BEARING CAPACITY AND SLOPE STABILITY **9**

Bearing capacity of soils - Factors affecting Bearing Capacity- Shallow foundations- Terzaghis formula- BIS standards - Slope stability-Analysis of infinite and finite slopes- friction circle method- slope protection measures.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course the student will be able to understand

- To describe the various minerals and organic components of soils including how changes in various quantities affect soil physical properties. It is a basic understanding of soil reaction, especially how they relate to nutrient availability.
- An introductory understanding of soil classifications along with land use and problematic soil, including the favorable traits and limitations of the various soil orders.
- Apply principles of phase diagram for soil properties, their classification and also understand the basic science of soil compaction.
- Learn the concept of engineering properties through standard tests and understand principles of slow and soil permeability through porous medium.
- Understanding the basic concepts of ultimate bearing capacity of shallow foundations including bearing capacity equations and slope stability problems.

TEXT BOOKS:

1. Nyle C. Brady., "The Nature and Properties of Soil", Macmillan Publishing Company, 10th Edition, New York, 2008.
2. Punmia, B.C., "Soil Mechanics and Foundation", Laxmi Publishers, New Delhi, 2007.

REFERENCE BOOKS:

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

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1902302 FLUID MECHANICS AND HYDRAULICS L T P C

3 0 0 3

OBJECTIVES:

- To introduce the students to the mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions.
- The students are exposed to the dynamics of fluids, introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
- To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on vanes.
- To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic pumps.
- At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering.

UNIT-I: PROPERTIES OF FLUID 9

Properties of fluids – definition – units of measurement - Mass density – specific weight, specific volume – specific gravity - equation of state – perfect gas - Viscosity – vapour pressure – compressibility and elasticity - surface tension – capillarity. Fluid pressure and measurement – simple, differential and micro manometers - Mechanical gauges – calibration. Hydrostatic forces on surfaces – total pressure and centre of pressure -

Horizontal- vertical and inclined plane surface - Pressure diagram – total pressure on curved surface. Archimedes principles –buoyancy- metacentre – metacentric height.

UNIT-II: FLUID FLOW ANALYSIS **9**

Types of fluid flow – velocity and acceleration of a fluid particle - Rotational – irrotational circulation and vorticity - Flow pattern – stream line – equipotential line – stream tube path line – streak line – flow net – velocity potential – stream function. Principles of conservation of mass – energy – momentum – continuity equation in Cartesian co-ordinates - Euler's equation of motion.

UNIT-III: FLOW MEASUREMENT **9**

Bernoulli's equation – applications - Venturimeter – orifice meter – nozzle meter - rotameter – elbow meter - pitot tube – Orifice – sharp edged orifice discharging free - submerged orifice – mouth piece - Flow through orifice under variable head – time of emptying a tank with and without inflow. Flow through pipes – laminar and turbulent flow in pipes - Reynold's experiment - Darcy – Weisbach equation for friction head loss – Chezy's formula – Manning's formula – Hazen- William‟ s formula - Major and minor losses in pipes – hydraulic gradient line – energy gradient line. Siphon – water hammer in pipes – gradual and sudden closure of valves

UNIT-IV: OPEN CHANNEL FLOW **9**

Types of flow in channel – uniform flow – most economical section of channel – rectangular – trapezoidal. Specific energy and critical depth - momentum in open channel flow – specific force – critical flow – computation. Flow measurement in channels – notches – rectangular, Cipolletti and triangular – float method - Flow measurement in rivers/ streams/ canals – weirs – free and submerged flow – current meter – Parshall flume.

UNIT-V: DIMENSIONAL ANALYSIS & PUMPS **9**

Dimensional analysis – Fundamental dimensions – dimensional homogeneity – Rayleigh’s method and Buckingham Pi-Theorem - concept of geometric, kinematic and

dynamic similarity. Important non dimensional numbers – Reynolds, Froude, Euler, Mach and Weber - Pump terminology – suction lift, suction head, delivery head, discharge, water horse power – selection of pump capacity. Centrifugal pumps – components – working – types of pumps and impellers - Priming – cavitation – specific speed – characteristic curves. Turbine and submersible pumps - Jet pump – jet assembly - Other pumps – Air lift pump - reciprocating pump - sludge pump and vacuum pump- Hydraulic ram.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to get a basic knowledge of fluids in static, kinematic and dynamic equilibrium.
- To understand the types of flow and its pattern.
- Apply the various methods of field measurements and empirical formulae for pipe flow.
- Compute, analyse, and manage the open channel flow.
- They will also gain the knowledge of the applicability of physical laws in addressing problems in hydraulics.

TEXT BOOKS:

1. Modi, P.N. and Seth S.M., “Hydraulics and Fluid Mechanics”, Standard Publishers Distributors, New Delhi, 2010.
2. Bansal, R.K., “A text book of Fluid Mechanics and Hydraulic Machinery”, Laxmi Publications (P) Ltd., New Delhi, 2002.
3. Jagdish Lal, “Hydraulic Machines”, Metropolitan Book House, New Delhi, 2000.

REFERENCE BOOKS:

1. Garde, R.J., “Fluid Mechanics through problems”, New Age International Publishers (P) Ltd., New Delhi, 2002.
2. Michael A.M. and S.D. Khepar, “Water Well and Pump Engineering”, Tata McGraw Hill Co. New Delhi, 2005.
3. Michael A.M., “Irrigation Theory and Practice”, Vikas Publishing House, New Delhi, 2008.

WEBSITES:

1. www.onesmartclick.com/engineering/fluid-mechanics.html
2. www.it.iitb.ac.in/vweb/engr/civil/fluid_mech/course.html

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1909308 THEORY OF MACHINES L T P C

3 0 0 3

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Apply the basic components of mechanisms.
- Apply the basic knowledge on the friction applications.
- Design cam mechanisms for specified output motions.
- Apply the basic concepts of toothed gearing and kinematics of gear trains.
- Analyze the effects of inertia, turning moment and balancing of rotating and reciprocating masses.

UNIT-I: TERMINOLOGY 9

Definitions - Kinematic links - Pairs - Chain - Machines and mechanism - Types and uses – Kinematic inversion of four bar chain and slider crank mechanism. Velocity and acceleration in simple mechanisms - Vector polygon and instantaneous centre methods – Coriolis component of acceleration.

UNIT-II: FRICTION AND APPLICATION 9

Sliding and rolling friction –friction in screw threads-Bearing and lubrication- Friction clutches- Belt drives- Friction aspects in brakes.

UNIT-III: MOTION OF CAM AND FOLLOWER **9**

Cam and follower - types - application – displacement diagrams - profile layout for uniform velocity Uniform acceleration and retardation - simple harmonic and cycloidal motion.

UNIT-IV: GEARS AND GEAR TRAINS **9**

Gears - classification - terminology -law of gearing - tooth profile - interference between rack and pinion. Gear trains - simple - compound reverted. Simple epicyclic gear trains.

UNIT-V: FLYWHEEL AND BALANCING **9**

Inertia - turning moment - flywheel - fluctuation of speed and energy. Balancing of rotating masses and reciprocating masses.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Apply the basic components of mechanisms.
- Apply the basic knowledge on the friction applications.
- Design cam mechanisms for specified output motions.
- 4. Apply the basic concepts of toothed gearing and kinematics of gear trains.
- 5. Analyze the effects of inertia, turning moment and balancing of rotating and reciprocating masses.

TEXTBOOKS:

1. Rattan, S.S, “Theory of Machines”, 3rd Edition, Tata McGraw-Hill, 2009.
2. Khurmi, R.S. and Gupta, J.K., “Theory of machines”, Eurasia Publication House, 1994.

REFERENCE BOOKS:

1. Thomas Beven, “Theory of Machines”, CBS Publishers and Distributors,

NewDelhi, 1984.

2. Ballaney, P.L., “Theory of machines”, Khanna Publishers, NewDelhi, 1994.

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1902303 SURVEYING AND LEVELLING L T P C

3 0 0 3

OBJECTIVES:

- To introduce the fundamentals of surveying, its principles, accessories for chain and ranging.
- To expose students about the concepts of compass and plane table surveying.
- To learn the various types of theodolite and modern surveying.
- To introduce the concepts of levelling.
- To impart knowledge on levelling applications.

UNIT-I: FUNDAMENTALS AND CHAIN SURVEYING 9

Definition- Classifications - Basic principles – Equipment and accessories for ranging and chaining – Methods of ranging - well conditioned triangles – Errors in linear measurement and their corrections - Obstacles - Traversing – Plotting – applications- enlarging and reducing figures- Areas enclosed by straight lines - Irregular figures- digital Planimeter.

UNIT-II: COMPASS AND PLANE TABLE SURVEYING 9

Compass – Basic principles - Types - Bearing – Systems and conversions – Sources of Errors - Local attraction - Magnetic declination-Dip-Traversing - Plotting - Adjustment of closing error – applications - Plane table and its accessories - Merits and demerits - Radiation - Intersection- Resection – Traversing- sources of errors – applications.

UNIT-III: THEODOLITE AND MODERN SURVEYING 9

Theodolite - Types - Description - Horizontal and vertical angles - Temporary and Permanent adjustments – Heights and distances– Tangential and Stadia Tacheometry – Subtense methods - Stadia constants - Anallactic lens - Traversing - Gale" s table - Total Station- GIS- Global Positioning System (GPS).

UNIT-IV: LEVELLING 9

Level line - Horizontal line - Datum - Bench marks -Levels and staves - temporary and permanent adjustments – Methods of leveling - Fly levelling - Check levelling - Procedure in levelling - Booking -Reduction - Curvature and refraction - Reciprocal levelling - sources of errors in leveling- Precise levelling - Types of instruments - Adjustments – Field procedure.

UNIT-V: LEVELLING APPLICATIONS 9

Longitudinal and Cross-section-Plotting - Contouring - Methods – Characteristics and uses of contours- Plotting – Methods of interpolating contours – computation of cross sectional area and volumes - Earthwork calculations - Capacity of reservoirs - Mass haul diagrams.

TOTAL: 45 PERIODS

OUTCOMES:

- To carry out preliminary surveying in the field of Agricultural and Irrigation engineering applications.
- To gain knowledge on plane table surveying and its adjustments.
- To plan a survey, taking accurate measurements, field booking, plotting and adjustment of traverse.
- To have understanding on levelling, methods of levelling, instruments used for

- levelling and its adjustments.

- To apply surveying techniques for road alignment and height of the building.

TEXT BOOKS:

1. James M. Anderson and Edward M. Mikhail, “Surveying Theory and Practice”, Seventh Edition, McGraw Hill2001.
2. Bannister and S. Raymond, “Surveying”, Seventh Edition, Longman2004.

REFERENCE BOOKS:

1. S.K. Roy, “Fundamentals of Surveying”, Second Edition, Prentice Hall of India 2004.
2. A.M. Chandra, “Plane Surveying”, New Age International Publishers2002.
3. Alak De, “Plane Surveying”, S. Chand & Company Ltd., 2000.

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1905309 SOLAR AND WIND ENERGY ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- 1 To impart knowledge on solar energy systems, wind energy systems and its applications.

- To make students understand the fundamental theory governing solar thermal and photovoltaic devices.

- To understand the processes of generation of wind, its potential and energy extraction.

- To know about different PV panel configurations and its characteristics.
- To understand use of solar energy for different applications like cooking,desalination, space heating etc.

UNIT-I: SOLAR ENERGY RADIATION AND SOLAR THERMAL COLLECTORS 9

Solar energy - Introduction-Solar constant- Solar Radiation at the Earth's surface-measurements of solar radiation-pyronometer- pyrheliometer- sunshine recorder- – Solar collectors - Flat plate collectors - heat transfer correlations - collector efficiency - heat balance – absorber plate – types - selective surfaces. Solar water heaters - types- their performance. Solar driers – types – heat transfer - performance of solar dryers – agro industrial applications.

UNIT-II: SOLAR CONCENTRATING COLLECTORS 9

Concentrating collectors – types – reflectors - solar thermal power stations – principle and applications - Solar energy storage systems – thermal - sensible and latent heat, chemical, electrical, electro-magnetic energy storage – selection of materials for energy storage - Solar distillation – application - Solar stills - types - Solar pond - performance – characteristics - applications – Solar refrigeration

UNIT-III: SOLAR PV TECHNOLOGY 9

Solar photovoltaic technology –introduction – solar cell basics – Types of solar cells and modules – encapsulation – Design of solar PV system – load estimation - batteries – invertors – operation - system controls. Standalone and grid connected systems - PV powered water pumping - Hybrid system - Solar technologies in green buildings.

UNIT-IV: WIND ENERGY 9

Nature of the wind – power in the wind – factors influencing wind – wind energy potential and installation in India- wind speed monitoring - wind resource assessment - wind power laws - velocity and power duration curves - Betz limit - site selection.

UNIT-V: TYPES OF WIND POWER AND ITS APPLICATIONS 9

Wind energy conversion devices - classification, characteristics, applications – Design of horizontal axis wind mill rotor diameter - Wind energy storage - wind farms - wheeling

and banking - testing and certification procedures. Water pumping - Hybrid systems – Wind mill safety and environmental aspects.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the concepts of solar and wind energy resources.
- Understand the applications of solar and wind energy systems.
- Acquired skills on the choice of energy conversion technique for specific applications.
- Identify pros and cons of energy resources.
- Understand the operation of a wind farm and economics of power generation.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1		2			1					3	2	3			
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1902304 SURVEYING AND LEVELLING LABORATORY L T P C

0 0 4 2

OBJECTIVES:

- To train the student to acquire skill on chain and compass surveying.
- To train students to gain experience on plane table surveying.
- To have hands on experience on operating theodolite.
- To gain practical knowledge on levelling.
- To expose students to the total station and GPS outcome.

1. **CHAIN SURVEYING**

   Ranging, Chaining and Pacing Chain traversing

2. **COMPASS SURVEYING**

   Triangulation Problem Compass traversing

3. **PLANE TABLE SURVEYING**

   Radiation

   Intersection - Triangulation problem Plane table traversing

4. **THEODOLITE SURVEYING**

   Measurement of horizontal & vertical angles Tangential & Stadia Tacheometry

5. **LEVELLING**

   Fly levelling using Dumpy level Fly levelling using Tilting level Check levelling Block Levelling Radial Contouring

6. **DEMONSTRATION OF TOTAL STATION AND GPS OUTCOME:**

Students completing this course would have acquired practical knowledge on handling basic survey instruments including leveling and development of contour map of given area.

TOTAL: 60 PERIODS

OUTCOMES:

- To use conventional surveying tools such as chain/tape in the field of agricultural and irrigation engineering applications.
- To apply field procedures in basic types of surveys with compass, as part of a surveying team.
- To plot traverses / sides of the plot and determine the location of points present on field on a piece of paper.
- To use the theodolite along with chain/tape, compass on the field.
- To take accurate measurements, field booking, plotting and adjustment of errors can be understood.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

Sl.No.	Description of Equipment	Quantity
1.	Total Station	3 nos
2.	Theodolites	Atleast 1 for every 5 students
3.	Dumpy level / Filling level	Atleast 1 for every 5 students
4.	Pocket stereoscope	1
5.	Ranging rods	1 for a set of 5 students
6.	Levelling staff	
7.	Cross staff	
8.	Chains	
9.	Tapes	
10.	Arrows	
11.	Prismatic Compass	10 nos

12.	Surveyor Compass	2 nos
13.	Survey grade or Hand held GPS	3 nos

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
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2	2	3	-	-	1	2	-	1	3	2	-	3	3	1	3	2
3	3	3	-	-	1	2	-	1	3	2	-	3	3	3	3	2
4	2	2	-	-	1	1	-	-	3	3	2	3	3	1	2	3
5	3	3	2	3	2	2	2	1	3	2	2	2	2	2	2	3

1902305 FLUID MECHANICS LABORATORY L T P C

0 0 2 1

OBJECTIVES:

- To have a knowledge on flow measurements using various devices.
- To give hands on experience on the flow through different types of notches.
- To gain experimental knowledge on computation of major losses in pipes.
- To train students on determination of minor losses in pipes.
- To study the characteristics of various pumps.

LIST OF EXPERIMENTS

1. FLOW MEASUREMENT

- Calibration of Rotameter
- Flow through Venturimeter
- Flow through a circular Orifice
- Determination of mean velocity by Pitot tube
- Flow through a Triangular Notch
- Flow through a Rectangular Notch

2. LOSSES IN PIPES

- Determination of friction coefficient in pipes

- Determination of losses due to bends, fittings and elbows

3. PUMPS

- Characteristics of Centrifugal pump
- Characteristics of Submersible pump
- Characteristics of Reciprocating pump

OUTCOMES:

- The students will be able to measure flow through pipes.
- The students will be able to measure flow in open channel.
- The students will be able to compute the major and minor losses in pipes.
- The students will be able to study the characteristics of pumps.
- The students will be able to analyse the performance of pumps.

TOTAL: 30 PERIODS

REFERENCE BOOKS:

1. “Hydraulic Laboratory Manual”, Centre for Water Resources, Anna University, 2004.
2. Modi P.N. and Seth S.M., “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi, 2000.
3. Subramanya, K., “Flow in Open Channels”, Tata McGraw - Hill Pub. Co.1992.
4. Subramanya, K., “Fluid Mechanics”, Tata McGraw- Hill Pub. Co., New Delhi, 1992.

LIST OF EQUIPMENTS REQUIRED

- Rotameter – 1 no.
- Venturimeter – 1 no.
- Orifice meter – 1 no.
- Pitot tube – 1 no.
- Bernoulli‟ s theorem apparatus – 1 no.
- Triangular notch and Rectangular notch – 1 each (with a lined open channel setup)
- Coefficient of friction apparatus
- Pipe setup with bends, fittings and elbows for estimating minor losses
- Centrifugal pump, Reciprocating pump, Submersible pump, Jet pump – 1 each

- Collecting tank, Stop watch – 1 no. for each experiment.

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	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
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2	3	3	2	-	-	-	2	2	-	-	-	2	3	2	3	2
3	3	3	3	2	-	-	1	2	-	-	1	2	3	1	2	2
4	3	3	-	-	-	1	-	-	-	-	2	3	2	1	2	3
5	3	3	2	2	-	-	2	-	-	-	2	3	2	3	2	3

1919001 COMMUNICATION SKILLS LAB - PROJECT BASED L T P C

0 0 2 0

OBJECTIVES:

The Course will enable learners to:

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities and make effective presentations.
- Improve general and academic listening skills and technical writing skills.
- Strengthen the reading skills of students of engineering.
- Provide more opportunities to develop their project and proposal writing skills.

UNIT- I: 6

Listening - Listening as a key skill- its importance- **Speaking** - give personal information - ask for personal information - express ability - enquire about ability – rephrase for clarification or emphasis - Improving pronunciation – Articulation of speaking –vowel sounds. **Reading** – Strategies for effective reading- Read and recognize different text types in a newspaper - **Writing**-Plan before writing- Develop a

paragraph: topic sentence, supporting sentences, concluding sentence.

UNIT- II: **6**

Listening - Listen to a process information- **Speaking** - asking for details formal/informal – give views, opinions and justification of a news- consonant sounds – diphthongs - .**Reading**-Read for vocabulary through scientific invention summarise the same into a paragraph- . **Writing**- compare and contrast ideas using adjectives from multiple sources stating reasons and examples to support ideas. Write a paragraph with reasons and examples- Write a rejoint to a newspaper expressing opinions on particular news.

UNIT-III: **6**

Listening - Lexical chunking for accuracy and fluency- factors that influence fluency- listen for and follow the gist- listen for detail **Speaking** - deliver a five-minute informal talk - invite and offer - accept - decline - take leave - word stress – stress rules-ability to recognize RP sound- . **Reading**– Skimming / Scanning a text to apply both the concepts – to search – to analyze.**Writing**–Use of dictionary and usage of synonyms- editing and proof reading.

UNIT-IV: **6**

Listening - Being an active listener: giving verbal and non-verbal feedback- listening to a podcast of a native speaker and reciprocating **Speaking** - participating in a group discussion - conversational speech listening to and participating in conversations - persuade.– Sentence stress – intonations types-features of connected speech **Reading**– Genre and Organization of Ideas- note taking and summarizing **Writing–** Email writing- Job application- Blog writing.

UNIT-V: **6**

Listening - Listening to documentaries and make notes (TED talks) **Speaking** -Power point presentation - strategies for presentations and interactive communication -

group/pair presentations –use stress and intonation to convey meaning and nuances of meaning clearly- **Reading**– Technical passages for comprehension- understanding how the text positions the reader- **Writing**– Statement of Purpose - analyse the situation in a picture / photo and write a suitable description with a proper title

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course Learners will be able to:

- Read and evaluate texts critically.
- Make effective presentations.
- Participate confidently and appropriately in conversations both formal and informal.
- Write winning job applications.
- Display critical thinking in Various Professional Contexts.

REFERENCE BOOKS:

1. Gramer F.Margot and Colin S.Ward ‘Reading and Writing’ (Level 3) Oxford University Press: Oxford, 2011.
2. Debra Daise, CharlNorloff, and Paul ‘Reading and Writing’ (Level 4) Oxford University Press: Oxford, 2011
3. Brooks, Margret. ‘Skills for Success. Listening and Speaking.’ (Level 4)Oxford University Press, Oxford: 2011.
4. Richards,C. Jack. & David Bholke. ‘Speak Now’(Level 3.) Oxford University Press, Oxford: 2010
5. Davis,Jason and Rhonda LIss. ‘Effective Academic Writing’ (Level 3) Oxford University Press: Oxford, 2006
6. E.Suresh Kumar. ‘Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012
7. Petelin, Roslyn and Marsh Durham. ‘The Professional Writing Guide: Knowing Well and Knowing Why’. Business & Professional Publishing: Australia, 2004.
8. Bhatnagar, Nitin and Mamta Bhatnagar. ‘Communicative English for Engineers and Professionals’. Pearson: New Delhi, 2010.

9. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
10. Vargo, Mari. Speak Now (Level 4). Oxford University Press: Oxford, 2013.
11. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
12. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014
13. IELTS, TOFEL testing series

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	3	3	-	-	-	-	3	-	1	-	2	2	2
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4	3	3	-	-	-	-	3	-	-	2	-	1	1	1	2	2
5	3	2	2	-	-	-	-	-	-	3	-	1	2	2	1	1

1918404 PROBABILITY AND STATISTICS L T P C

3 1 0 4

OBJECTIVES:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables and concepts of two dimensional random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples this plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments this plays very important roles in the field of agriculture and statistical quality control.

UNIT-I: RANDOM VARIABLES 9L+3T

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT-II: TWO - DIMENSIONAL RANDOM VARIABLES **9L+3T**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables, Central limit Theorem.

UNIT-III: TESTING OF HYPOTHESIS **9L+3T**

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 for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT-IV: DESIGN OF EXPERIMENTS **9L+3T**

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design.

UNIT-V: STATISTICAL QUALITY CONTROL ` **9L+3T**

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 45L+15T PERIODS

OUTCOMES:

- Students will be able to understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS:

1. T. Veerarajan, - Probability, Statistics Random Processes with Queueing Theory and Queueing Networks (Third Edition), Tata McGraw-Hill Publishers
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
3. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

REFERENCE BOOKS:

1. P.Sivaramakrishna Das, C.Vijayakumari , "Probability and Statistics", Second Edition, Pearson India Education Services Pvt. Ltd, 2017
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
5. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

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3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	1	-
4	3	3	3	-	-	-	-	-	-	-	-	-	-	-	1	-
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No Correlation - Low 1 Medium 2 High 3

1902401 UNIT OPERATIONS IN AGRICULTURAL PROCESSING L T P C

3 0 0 3

OBJECTIVES:

- The students are exposed to the fundamental knowledge in Evaporation.
- To gain knowledge on Filtration, its types and equipments.
- To introduce students to the concepts of Sedimentation
- To impart knowledge on the concepts of Processing, Sieve analysis.
- To gain knowledge on the principles of Crystallization and Distillation in processing of agricultural produce.

UNIT-I: EVAPORATION AND CONCENTRATION 9

Unit operations in food processing - Conservation of mass and energy - Overall view of an engineering process - Dimensions and units - Dimensional and unit consistency - Dimensionless ratios - Evaporation - Definition - Liquid characteristics - Single and multiple effect evaporation - Performance of evaporators and boiling point elevation - Capacity - Economy and heat balance -Types of evaporators - Once through and circulation evaporators - Short tube evaporators and long tube evaporators - Agitated film evaporator.

UNIT-II: MECHANICAL SEPARATION 9

Filtration - Definition - Filter media - Types and requirements - Constant rate filtration - Constant pressure filtration - Filter cake resistance - Filtration equipment - Rotary vacuum filter - Filter press - Sedimentation - Gravitational sedimentation of particles in a fluid - Stoke's law, sedimentation of particles in gas - Cyclones - Settling under sedimentation and gravitational sedimentation - Centrifugal separations - Rate of separations - Liquid - Liquid separation - Centrifuge equipment.

UNIT-III: SIZE REDUCTION 9

Size reduction - Grinding and cutting - Principles of comminuting - Characteristics of comminuted products - Particle size distribution in comminuted products - Energy and power requirements in comminuting - Crushing efficiency - Rittinger’s, Bond’s and Kick’s

laws for crushing - Size reduction equipments - Crushers - Jaw crusher, gyratory crusher - Crushing rolls - Grinders - Hammer mills - Rolling compression mills - Attrition, rod, ball and tube mills - construction and operation.

UNIT-IV: CONTACT EQUILIBRIUM SEPARATION 9

Contact equilibrium separation processes - Concentrations - Gas - Liquid and solid - Liquid equilibrium concentration relationships - Operating conditions - Calculation of separation in contact equilibrium processes - Gas absorption - Rate of gas absorption - Stage - Equilibrium gas - Absorption equipment - Properties of tower packing - Types - Construction - Flow through packed towers - Extraction - Rate of extraction - Stage equilibrium extraction - Equipment for leaching coarse solids - Intermediate solids - Basket extractor - Extraction of fine material - Dorr agitator - Continuous leaching - Decantation systems - Extraction towers - Washing - Equipments.

UNIT-V: CRYSTALLISATION AND DISTILLATION 9

Crystallization - Equilibrium - Rate of crystal growth stage - Equilibrium crystallization- Crystallizers- Equipment - Classification- Construction and operation - Crystallizers - Tank-Agitated batch- Swenson-Walker and Vacuum crystallizers-Distillation-Binary mixtures - Flash and differential distillation - Steam distillation - Theory - Continuous distillation with rectification - Vacuum distillation - Batch distillation - Operation and process - Advantages and limitation -Distillation equipments - Construction and operation - Factors influencing the operation.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Fundamentals of evaporation and concentration.
- Principles of mechanical separation.
- Characteristics and principles of size reduction.
- Material handling equipments.
- Construction, Operation and process of crystallization and distillation.

TEXTBOOKS:

1. Earle. R.L., “Unit operations in Food Processing”, Pergamon Press, Oxford, U.K, 1985.
2. McCabe. W.L., and Smith. J.C., “Unit Operations of Chemical Engineering”, Mc-Graw-Hill Inc., Kosaido Printing Ltd., Tokyo,1990.
3. Geankoplis. C.J., “Transport Processes and Separation Process Principles”, 4th Edition, Prentice Hall, 2003.

REFERENCE BOOKS:

1. Coulson. J.M and Richardson. J.F., "Chemical Engineering", Volume I to V, The Pergamon Press, New York, 1999.
2. Albert Ibarz and Gustavo V. Barbosa-Cánovas, "Unit Operations in Food Engineering", CRC Press LLC, Florida, 2003.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
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3	2	1	-	2	1	-	2	-	2	-	2	2	2	2	3	3
4	2	2	1	2	1	-	2	-	1	-	1	3	3	3	2	3
5	3	1	2	1	1	-	2	-	2	-	-	2	2	3	2	3

1909407 **FARM TRACTORS** **L T P C**

3 0 0 3

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- To understand the construct the tractor engines.
- To analyze the engine construction and various systems involved.
- To analyze various power transmission system and brakes.
- To analyze the tractor hydraulic systems.
- To analyze power tiller and testing of tractors.

UNIT-I: TRACTORS **9**

Classification of tractors - Tractor engines - Construction of engine blocks, cylinder head and crankcase - Features of cylinder, piston, connecting rod and crankshaft - Firing order combustion chambers.

UNIT-II: ENGINE SYSTEMS **9**

Valves- inlet and outlet valves - Valve timing diagram - Air cleaner - Exhaust – Silencer - Cooling systems - Lubricating systems - Fuel system - Governor- Electrical system.

UNIT-III: TRANSMISSION SYSTEMS **9**

Transmission - Clutch - Gear box - Sliding mesh - Constant mesh - Synchro mesh - Differential, final drive and wheels steering geometry - Steering systems - Front axle and wheel alignment - Brake - Types - System.

UNIT-IV: HYDRAULIC SYSTEMS **9**

Hydraulic system - Working principles, three point linkage - draft control - Weight transfer, theory of traction - Tractive efficiency - Tractor chassis mechanics - Stability - Longitudinal and lateral Controls - Visibility - Operators seat.

UNIT-V: POWER TILLER, BULLDOZER AND TRACTOR TESTING **9**

Power tiller - Special features - Clutch - Gear box - Steering and brake - Makes of tractors, power tillers and bulldozers. Bulldozer - Salient features - Turning mechanism, track mechanism, components - Operations performed by bulldozers - Types of tests - Test procedure - Need for testing & evaluation of farm tractor - Test code for performance testing of tractors and power tillers.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Construct the tractor engines.
- Analyze the engine systems.
- Analyze various power transmission system and brakes.

- Analyze the tractor hydraulic systems.
- Analyze power tiller and testing of tractors.

TEXT BOOK:

1. Jain. S.C., and Rai. C.R., "Farm tractor maintenance and repair", Standard publishers and distributors, New Delhi, 1999.
2. JagadeeshwarSahay, “Elements of Agricultural Engineering”, Standard Publishers Co.,

REFERENCE BOOKS:

1. Barger. E.L., Liljedahl. J.B. And McKibben. E.C., “Tractors and their Power Units”, Wiley Eastern Pvt. Ltd., New Delhi, 1997.
2. Domkundwar. A.V., “A course in internal combustion engines”, Dhanpatrai & Co. (P) Ltd., Educational and Technical Publishers,Delhi, 1999.
3. Black. P.O., “Diesel engine manual”, Taraporevala Sons & Co., Mumbai, 1996.
4. Grouse. W.H. and Anglin. D.L., “Automative mechanics”, Macmillan McGraw- Hill, Singapore, Indian Standard Codes for Agricultural Implements Published by ISI, New Delhi, 1993.

CO	PO												PSO			
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1902402 HYDROLOGY AND WATER RESOURCES ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To introduce the student to the concept of hydrological aspects of water

availability and requirements.

- Students should be able to quantify, control and regulate the water resources.
- To have an insight on runoff, flow measurements and hydrographs, flood, drought.
- To have exposure on flood and drought analysis.
- To have a deep learning on principles and design of reservoirs, ground water and its management.

UNIT-I: PRECIPITATION AND ABSTRACTIONS **9**

Hydrological cycle - Meteorological measurements - Requirements, types and forms of precipitation - Rain gauges - Spatial analysis of rainfall data using Thiessen and Isohyetal methods - Interception - Evaporation - Horton's equation, pan evaporation measurements and evaporation suppression - Infiltration - Horton's equation - double ring infiltrometer, infiltration indices.

UNIT-II: RUNOFF **9**

Watershed, catchment and basin - Catchment characteristics - Factors affecting runoff - Run off estimation using empirical - Strange's table and SCS methods - Stage discharge relationships- Flow measurements - Hydrograph - Unit Hydrograph - IUH

UNIT-III: FLOOD AND DROUGHT **9**

Natural Disasters - Flood Estimation - Frequency analysis - Flood control - Definitions of droughts - Meteorological, hydrological and agricultural droughts - IMD method - NDVI analysis- Drought Prone Area Programme (DPAP)

UNIT-IV: RESERVOIRS **9**

Classification of reservoirs, General principles of design, site selection, spillways, elevation -area - capacity - storage estimation, sedimentation - life of reservoirs - rule curve

UNIT-V: GROUND WATER AND MANAGEMENT **9**

Origin - Classification and types - properties of aquifers - Governing equations - Steady and unsteady flow - Artificial recharge - RWH in rural and urban areas

TOTAL: 45 PERIODS

OUTCOMES:

The students completing the course will have

- An understanding of the key drivers on water resources, hydrological processes and their integrated behavior in catchments.
- Apply the knowledge of hydrological models to surface water problems including basin characteristics, runoff and Hydrograph.
- Explain the concept of hydrological extremes such as Flood and Drought and management strategies.
- Ability to conduct spatial analysis of rainfall data and design water storage reservoirs.
- Understand the concept and methods of ground water management.

TEXT BOOKS:

1. Subramanya .K., "Engineering Hydrology", Tata McGraw Hill, 2010
2. Jayarami Reddy .P.k., "Hydrology", Tata McGraw Hill, 2008.
3. Linsley.R.K., and Franzini.J.B., "Water Resources Engineering", McGraw Hill International Book Company,1995.

REFERENCE BOOKS:

1. David Keith Todd, "Groundwater Hydrology", John Wiley & Sons, Inc., 2007
2. VenTe Chow, Maidment. D.R. and Mays. L.W., "Applied Hydrology", McGraw Hill International Book Company, 1998.
3. Raghunath. H.M., "Hydrology", Wiley Eastern Ltd., 1998.

CO	PO												PSO			
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1902403 STRENGTH OF MATERIALS L T P C

3 0 0 3

OBJECTIVES:

- To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.
- To have understanding on the analysis of plane trusses.
- To gain knowledge on transverse loading and stresses in beam.
- To introduce the concept of torsion in shafts.
- To impart knowledge on deflection of beams.

UNIT-I: STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids - Tension, Compression and Shear Stresses - Deformation of simple and compound bars - Thermal stresses - Elastic constants - Volumetric strains - Thin shells - circumferential and longitudinal stresses in thin cylinders - Deformation of thin cylinder - Stresses in spherical shells - Deformation of spherical shells.

UNIT-II: ANALYSIS OF PLANE TRUSSES 9

Determinate and indeterminate plane trusses - Determination of member forces by method of joints, method of sections and method of tension coefficient.

UNIT-III: TRANSVERSE LOADING AND STRESSES IN BEAM 9

Beams - Types transverse loading on beams - Shear force and bending moment in

beams - Cantilevers - Simply supported beams and over-hanging beams. Theory of simple bending - bending stress distribution - Shear stress distribution - Flitched beams - Carriage springs.

UNIT-IV: TORSION **9**

Torsion formula - Stresses and deformation in circular and hollows shafts - Stepped shafts - Deflection in shafts fixed at the both ends - Stresses in helical springs - Deflection of helical springs - carriage springs.

UNIT-V: DEFLECTION OF BEAMS **9**

Computation of slopes and deflections in determinate beams - Double Integration method –Macaulay's method - Area moment method - Conjugate beam method.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can be able to apply mathematical knowledge to calculate the deformation behaviour of simple structures.
- Critically analyse problem and solve the problems related to structural elements and analyse the deformation behavior for different types of loads.
- To know about framework, typically consisting of rafters, posts, and struts, supporting a roof, bridge, or other structure.
- Students will be able to determine the torsion, stresses and deformation in circular and hollow shafts.
- To find the deflection of beams through various methods.

TEXT BOOKS:

1. Bansal R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007.
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007.

REFERENCE BOOKS:

1. Egor .P. Popov, "Engineering Mechanics of Solids", Prentice Hall of India, New Delhi,2001
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher

Education Series, 2007.

3. Hibbeler.R.C., "Mechanics of Materials", Pearson Education, Low Price Edition,2007.
4. Ferdinand P. Been, Russell Johnson, J.R. and John J. Dewole, "Mechanics of Materials", Tata McGraw Hill Publishing, co. Ltd., New Delhi, 2005.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	2	2	-	-	-	1	-	-	1	-	2	2	2	1	2	3
2	2	3	2	1	1	1	-	-	-	-	-	2	2	2	2	3
3	3	2	2	1	1	1	-	-	-	-	-	2	2	2	2	3
4	3	3	2	2	1	1	-	-	-	-	-	3	3	2	3	2
5	2	2	2	1	1	2	-	-	-	-	2	3	3	3	2	3

1902404 PRINCIPLES AND PRACTICES OF CROP PRODUCTION L T P C

3 0 0 3

OBJECTIVES:

- To introduce the students to the principles of agricultural and horticultural crop production.
- Students will gain knowledge on how to select a crop and its establishment.
- To impart knowledge on nutrient application and weed management.
- To delineate the role of agricultural and irrigation engineers in relation to various crop production practices.
- To understand the production practices of agricultural and horticultural crops.

UNIT-I: AGRICULTURE AND CROP PRODUCTION 9

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

UNIT-II: CROP SELECTION AND ESTABLISHMENT **9**

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

UNIT-III: CROP MANAGEMENT **9**

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

UNIT-IV: PRODUCTION PRACTICES OF AGRICULTURAL CROPS **9**

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

UNIT-V: PRODUCTION PRACTICES OF HORTICULTURAL CROPS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of course, students will be able to understand the basics of agriculture and crop production.
- To gain knowledge on crop selection and establishment.
- To have insight on crop nutrition management.
- To exploit the production practices of agricultural crops.
- To exploit the production practices of horticultural crops.

TEXT BOOKS:

1. Rajendra Prasad, “Text Book of Field Crop Production”, Directorate of Information and Publication, Krishi 02 Anusandhan Bhavan, Pusa, New Delhi, 2005.
2. Reddy T., Sankara G.H. Yellamanda Reddi, “Principles of Agronomy”, Kalyani Publishers, New Delhi, 1995.

REFERENCE BOOKS:

1. Kumar, N., “Introduction to Horticulture”, Rajalakshmi Publications. Nagercoil, 1993.
2. Kumar, N., Abdul Khader, M. Rangaswami, P. and Irulappan, I., “Introduction to spices, Plantation crops, medicinal and aromatic plants”, Rajalakshmi Publications, Nagercoil.1993.
3. Shanmugavel .K.G., “Production Technology of Vegetable Crops”, Oxford India Publications, New Delhi. 1989.
4. Bose T. K. and L.P.Yadav., “Commercial Flowers”, Nayaprakash, Calcutta. 1989.
5. Crop Production Guide, Tamil Nadu Agricultural University Publication, Coimbatore. 2005.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	1	3	-	2	1	3	3	-	1	-	2	2	3	2	2	2
2	3	2	-	2	1	2	1	-	1	-	2	2	3	3	2	2
3	3	2	-	2	-	3	3	1	2	-	2	2	2	2	2	2
4	1	1	2	2	-	2	2	-	1	-	2	2	2	2	2	2
5	1	1	2	2	-	2	2	-	1	-	2	2	2	2	2	2

1902405 **SOIL SCIENCE LABORATOY** **L T P C**

0 0 2 1

OBJECTIVES:

- Students will be able to identify the types of rocks and minerals.
- Students should be able to verify various quality aspects of soil and water studied

in theory by performing experiments in lab.

- To provide hands on experience on the textural analysis of soil.
- Students should be able to determine the organic carbon and gypsum requirements.
- Students should be able to perform in situ tests on soil samples.

LIST OF EXPERIMENTS

1. Identification of rocks and minerals
2. Collection and processing of soil samples
3. Determination of soil moisture, EC and pH
4. Field density determination by Core Cutter and Sand Replacement method
5. Specific gravity determination by Pycnometer
6. Textural analysis of soil by International Pipette method
7. Grain size analysis by using Mechanical shaker
8. Determination of Organic carbon
9. Estimation of Gypsum requirements

TOTAL: 30 PERIODS

OUTCOMES:

- Learn about the identification of minerals referred under theory.
- Knowledge of field investigations including collection of soil sampling**,** Processing and storage through observation of soil.
- Understanding of the physical properties of soil and different laboratory methods
- Be able to perform test to identify the organic carbon and application of soil amendments through chemical analysis of soil.
- Students know the techniques to determine various physical and chemical properties of soil that are applicable for agriculture and irrigation by conducting appropriate tests.

REFERENCE BOOKS:

1. Punmia, B.C., “Soil Mechanics and Foundation Engineering”, Laxmi Publishers, New Delhi, 2007.

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

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1			3					1	1		1	2		3	1
2	2	2	1		2	1	1	1	1		2	2	2	2	2	2
3	1	1		2		1		1	1		1	2	2	2	2	1
4	1	1		2		1		1	1		1	2	2	2	2	1
5	1	1		2		1		1	1		1	2	2	2	2	1

1902406 STRENGTH OF MATERIALS LABORATORY L T P C

0 0 4 2

OBJECTIVES:

- To expose the students to the testing of different materials under the action of various forces.
- Determination of material properties experimentally.
- Experimental study on the deflection of beams.
- To have exposure on hardness test on metals.
- Experimental study on compression and deflection of beams.

LIST OF EXPERIMENTS

1. Tension test on steel rod
2. Compression test on wood
3. Double shear test on metal
4. Torsion test on mild steel rod
5. Impact test on metal specimen (Izod and Charpy)
6. Hardness test on metals (Rockwell and Brinell HardnessTests)
7. Deflection test on metal beam
8. Compression test on helical spring
9. Deflection test on carriage spring

TOTAL: 60 PERIODS

OUTCOMES:

- The students will have the required knowledge in the area of testing of materials and components of structural elements experimentally.
- Students will have knowledge on performing tension tests on steel materials.
- Students can experimentally determine the impact on the materials.
- On completion of the lab students will have deep knowledge on finding deflection of materials.
- Students will gain knowledge on hardness of the materials experimentally.

REFERENCE BOOKS:

1. Strength of Materials Laboratory Manual, Anna University, Chennai - 600025.
2. IS 1786-2008 (Fourth Revision, Reaffirmed 2013), "High strength deformed bars and wires for concrete reinforcement – Specification", 2008.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

Sl.No.	Description of Equipment	Quantity
1.	UTM of minimum 400 kN capacity	1
2.	Torsion testing machine	1
3.	Izod impact testing machine	1
4.	Hardness testing machine Rockwell Vicker's (any 2) Brinnel	1 each
5.	Beam deflection test apparatus	1
6.	Extensometer	1
7.	Compressometer	1
8.	Dial gauges	Few
9.	Le Chatelier's apparatus	2
10.	Vicat's apparatus	2

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	2	2	2	1	-	-	-	-	-	1	2	2	2	2	3	2
2	1	1	-	2	-	1	-	1	1	-	1	2	2	2	2	1
3	1	1	-	2	-	1	-	1	1	-	1	2	2	2	2	1
4	3	3	2	1	2	1	-	1	1	-	2	2	3	3	3	2
5	1	1	-	2	-	1	-	1	1	-	1	2	2	2	2	1

1902407 **CROP HUSBANDRY LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES:

- To provide hands on experience to students to prepare land for cultivation.
- To introduce the different crop production practices in wet land, dry land and garden land through hands on experience and demonstrations.
- To have hands on experience on nutrient management.
- Experimental study on water management and irrigation scheduling.
- To introduce about the harvesting tools and their techniques.

LIST OF EXPERIMENTS:

1. Field preparation studies
2. Seed selection and seed treatment procedures
3. Seed bed and nursery preparation
4. Sowing / Transplanting
5. Biometric observation for crops
6. Nutrient management studies
7. Water management and irrigation scheduling
8. Weed management studies
9. Integrated Pest Management studies
10. Harvesting
11. Post harvesting

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS REQUIRED

- A wet land / garden land for a minimum of 5 cents area for each / group of students.
- An open / borewell as water source to support cultivation.
- Digging spade 1 no.
- Crow bar 1 no.
- Hand weeder 2 nos
- Sickle 3 nos
- Shovel 2 nos
- Trowel 2 nos
- Hoe large 2 nos
- Mattock 1 no
- Rake 2 nos.

OUTCOMES:

- On completion of course, the students will be able to prepare field for cultivation.
- Students will be able to select quality of seeds.
- Students will have basic knowledge on preparing seed bed and nursery.
- Students will have hands on experience Water management and irrigation scheduling
- Students will be capable of performing irrigation from sowing till harvesting.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	2	2	2	1	1	1	2	2	2	1	2	3	3	2	3	2
2	3	1	-	3	2	1	3	-	-	-	2	2	2	2	2	1
3	2	2	2	1	1	1	2	2	2	2	1	2	3	2	3	2
4	3	1	-	3	2	1	3	-	-	-	2	2	2	2	2	1
5	3	1	-	3	2	1	3	-	-	-	2	2	2	2	2	1

SEMESTER V

1902501 IRRIGATION AND DRAINAGE ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

At the completion of the course the students should be able

- To understand the necessity of planning an irrigation system to provide water at the right time and right place.
- To understand the basic concepts for planning, design and management of land drainage works in cultivated areas.
- To have vast knowledge on Agricultural farm development works.
- To understand the role of farmers' committee in water distribution and system operation.
- To learn in detail about agricultural drainage and recycling of drainage water for irrigation.

UNIT-I: WATER RESOURCES AND IRRIGATION REQUIREMENT 9

Water Resources- River basins-Development and Utilization in India and Tamil Nadu-Irrigation - Duty and delta - Rooting characteristics - Moisture use of crop, Evapotranspiration - ET plot - Crop water requirement - Effective rainfall - Scheduling - Irrigation requirement - Irrigation frequency, Irrigation efficiencies.

UNIT-II: METHODS OF IRRIGATION 9

Methods of Irrigation – Surface and Subsurface methods – Drip and Sprinkler - Hydraulics and design - Erodible and non-erodible, Kennedy's and Lacey's theories, Materials for lining water courses and field channel, Water control and diversion structure - Underground pipeline irrigation system.

UNIT-III: DIVERSION AND IMPOUNDING STRUCTURE 9

Head works - Weirs and Barrage -Types of impounding structures - Factors affecting, location of dams -Forces on a dam -Design of Gravity dams- Earth dams, Arch dams - Spillways -Energy dissipators.

UNIT-IV: CANAL IRRIGATION AND COMMAND AREA DEVELOPMENT 9

Classification of canals- Alignment of canals – Design of irrigation canals - Regime theories-Canal Head works - Canal regulators - Canal drops - Cross drainage works - Canal Outlet, Escapes -Lining and maintenance of canals - Excess irrigation and waterlogging problem - Command area - Concept, Components of CADP - On Farm Development works, Farmer's committee - its role for water distribution and system operation - Rotational irrigation system.

UNIT-V: AGRICULTURAL DRAINAGE 9

Agricultural drainage - Drainage coefficient; principles of flow through soils, Darcy's law – infiltration theory, Surface drainage systems - Subsurface drainage - Design of subsurface drainage - Pipe materials - mole drains, drainage wells, Leaching requirements - irrigation and drainage water quality - recycling of drainage water for irrigation.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will have knowledge and skills on Planning, design, operation and management of reservoir system.
- The student will gain knowledge on different methods of irrigation.
- To understand about diversion and impounding structures.
- To have an insight of canal classification, alignment and design of canals.
- To design agricultural drainage.

TEXT BOOKS:

1. Dilip Kumar Majumdar., "Irrigation Water Management", Prentice-Hall of India, New Delhi, 2008.
2. Michael, A.M, "Irrigation Engineering", Vikas Publishers, New Delhi, 2008.
3. Garg, S.K, "Irrigation Engineering," Laxmi Publications, New Delhi, 2008.
4. Ritzema, H.P, "Drainage Principles and Applications", Publication No. 16, International Institute of Land Reclamation and Improvement, Netherlands, 1994.

REFERENCE BOOKS:

1. Basak, N.N, “Irrigation Engineering”, Tata McGraw-Hill Publishing Co, New Delhi, 2008.
2. Murthy, V.V.N, “Land and water management”, Kalyani publishing, New Delhi, 1998.
3. Bhattacharya, A.K, and Michael, A.M, “Land Drainage – Principles, Methods and Applications”, Konark Publishers Pvt. Ltd., New Delhi, 2003.
4. Irrigation water Management, Training Manual No 6, Drainage of Irrigated Lands, Food and Agriculture Organisation, Rome, 1996.
5. Kessler, J, “Drainage Principles and Applications”, Vol. II and IV, International Institute of Land Reclamation and Improvement, Netherlands, 1979.

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	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	-	-	2	2	3	1	2	1	-	-	1	2	3	1	-	1
2	-	-	1	3	1	2	1	2	1	-	1	3	2	1	2	-
3	1	-	3	1	1	2	3	1	2	1	-	-	1	2	3	3
4	2	-	-	-	2	1	3	1	2	1	1	-	2	1	3	-
5	1	1	2	-	-	-	3	1	3	-	2	-	1	3	-	2

1902502 FARM MACHINERY AND EQUIPMENT L T P C

3 0 0 3

OBJECTIVES:

- To understand the different farm mechanization methods in detail.
- To introduce the students to the working principles of farm equipments, tillage implements.
- To expose the students to farm mechanization benefits and constraints, identification of components of primary and secondary tillage implements.
- To know about the principles of harvesting machinery.
- To understand the importance of weeding and plant protection equipments.

UNIT-I: FARM MECHANIZATION **9**

Farm mechanization - objectives. Tillage - objectives - methods - primary tillage implements - secondary tillage implements - animal drawn ploughs - construction. Types of farm implements - trailed, mounted. Field capacity - forces acting on tillage tool.

UNIT-II: PRIMARY AND SECONDARY TILLAGE IMPLEMENTS **9**

Mould board plough- attachments - mould board shapes and types. Disc plough - force representation on disc - Types of disc ploughs –Subsoiler plough - Rotary plough. Cultivators - types - construction. Disc harrows - Bund former – ridger- leveller. Basinlister-Wetland preparation implements.

UNIT-III: SOWING AND FERTILIZING EQUIPMENT **9**

Crop planting - methods - row crop planting systems - Devices for metering seeds – furrow openers – furrow closers- types – Types of seed drills and planters – calibration- fertilizer metering devices - seed cum fertilizer drills – paddy transplanters – nursery tray machines.

UNIT-IV: WEEDING AND PLANT PROTECTION EQUIPMENT **9**

Weeding equipment – hand hoe – long handled weeding tools – dry land star weeder – wetland conoweeder and rotary weeder – Engine operated and tractor weeders Sprayers –types-classification – methods of atomization, spray application rate, droplet size determination – volume median diameter, numerical median diameter – drift control.

UNIT-V: HARVESTING MACHINERY **9**

Principles of cutting crop, types of harvesting machinery, vertical conveyor reaper and binder combine harvesters, balers, threshers, tractor on top combine harvester, combine losses.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to understand the mechanization and various equipment used in the farm for different field operations.

- Students will have deep understanding on primary and secondary tillage implements.
- To gain knowledge on operation of sowing and fertilizing equipments.
- To know the operation of weeding and plant protection equipment.
- To have vast knowledge on operation of harvesting machinery.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Kepner, R.A., et al., “Principles of farm machinery” CBS Publishers and Distributers, Delhi. 99,1997.
2. Harris Pearson Smith et al., “Farm machinery and equipment”,Tata McGraw-Hill pub., New Delhi, 1996.
3. Srivastava, A.C, “Elements of Farm Machinery” Oxford and IBH Pub. Co., New Delhi, 1990.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	2	1	3	-	-	-	3	1	2	1	2	1	1	-	2	1
2	-	2	1	-	2	2	1	2	1	1	2	1	2	2	3	1
3	1	-	-	2	3	3	1	1	-	-	3	1	-	-	1	3
4	2	-	1	2	3	1	3	2	1	-	2	1	1	3	2	1
5	1	1	-	-	2	2	-	1	2	2	-	3	1	2	1	2

1909515 DESIGN OF BASIC MACHINE ELEMENTS L T P C

(Use of PSG Design Data book is permitted in the University Examination) **3 0 0 3**

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Select the materials and design machine members subjected to static and variable loads.
- Design the power transmission systems.
- Design shafts and couplings for various applications.
- Design helical, leaf springs and flywheels for various applications.
- Design and selection of gears and contact bearings.

UNIT-I: STRESSES IN MACHINE MEMBERS 9

Introduction to design process- factor influencing the machine design, selection of material based on mechanical properties- Direct, bending and torsional stress equations- calculation of Principal stresses for combined loading. Design of curved beams- factor of safety – theories of failure-stress concentration- design of variable loading- Soderberg and Goodman relations.

UNIT-II: DESIGN OF POWER TRANSMISSION SYSTEMS 9

Selection of V-Belts and pulleys- selection of flat belts and pulleys- wire ropes and pulleys- selection of transmission chains and sprockets. Design of pulleys and sprockets.

UNIT-III: DESIGN OF SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength and rigidity- Design of keys, keyway sand splines- Design of rigid and flexible couplings. Design of bolts and nuts - knuckle and cotter joints.

UNIT-IV: DESIGN OF ENERGYSTORING ELEMENTS 9

Design of helical, leaf, disc and torsional springs under constant loads and varying loads - Concentric torsion springs.

UNIT-V: DESIGN OF GEARS AND BEARINGS **9**

Gears - spur gear and helical gear - terminology - strength of gear teeth - Lewis equation - Buckingham equation.**-** Failure of gear teeth.- Applications of different types of Gears - Types of bearings – sliding contact and rolling contact types. – Bearing selection based on application - Lubrication in journal bearings – calculation of bearing dimensions.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students will be able to:

- Select the materials and design machine members subjected to static and variable loads.
- Design the power transmission systems.
- Design shafts and couplings for various applications.
- Design helical, leaf springs and flywheels for various applications.
- Design and selection of gears and contact bearings.

TEXT BOOKS:

1. Khurmi R.S and Gupta J.K, “A Textbook of Machine Design”, Euarsia publication house, 2005.
2. Bhandari V.B, “Design of Machine Elements”, Tata McGraw-Hill Book Co,2003.

REFERENCE BOOKS:

1. Norton R.L, “Machine Design – An Integrated Approach”, Pearson Publications, 3rd Edition, 2006.
2. Srivastava A.K, Goering.C E andRohrbach R.P. “Engineering Principles of Agricultural Machines”, Revised Printing by American Society of Agricultural Engineers.1993.
3. Gary Krutz, Lester Thompson and Paul Clear, “Design of Agricultural Machinery”, John Wiley and Sons, New York, 1984.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	3	-	-	-	-	1	-	-	-	2	3	3	-	-
2	2	2	3	-	-	-	-	1	-	-	-	2	3	3	-	-
3	2	2	3	-	-	-	-	1		-	-	2	3	3	-	-
4	2	2	3	-	-	-	-	1	-	-	-	2	3	3	-	-
5	2	2	3		-	-	-	1	-	-	-	2	3	3	-	-

1902503 POST HARVEST TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To expose the students to the fundamentals of various unit operations of Agricultural Processing
- To expose the students to different Post Harvest operations and processing methods of harvested crops
- To introduce material handling equipment, storage and waste utilization.
- To understand in-depth knowledge on the theory, methods, and equipment for the various unit operations of crop processing.
- To utilize the skills on post- harvest machines to increase the market value of the processed food products.

UNIT-I: FUNDAMENTALS OF POST - HARVESTING 9

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

UNIT-II: PSYCHROMETRY AND DRYING 9

Psychrometry – importance – Psychrometric charts and its uses – Drying – principles and theory of drying – thin layer and deep bed drying – Hot air drying – methods of producing hot air – Types of grain dryers – selection – construction, operation and maintenance of dryers – Design of dryers.

UNIT–III: CLEANING AND GRADING **9**

Principles - air screen cleaners – adjustments - cylinder separator - spiral separator – magnetic separator - colour sorter - inclined belt separator – length separators - effectiveness of separation and performance index.

UNIT–IV: SHELLING AND HANDLING **9**

Principles and operation – maize sheller, husker sheller for maize – groundnut decorticator – castor sheller – material handling – belt conveyor –screw conveyor – chain conveyor – bucket elevators – pneumatic conveying.

UNIT–V: CROP PROCESSING **9**

Paddy processing – parboiling of paddy – methods - merits and demerits - dehusking of paddy - methods – merits and demerits – rice polishers –types - constructional details – polishing -layout of modern rice mill - wheat milling – pulse milling methods - oil seed processing – millets processing.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the fundamental concepts of post-harvest technology and properties of agricultural materials, post-harvest operations and processing methods of harvested crops.
- Understand the concept and theory of drying and various dryers.
- Understand the principles of cleaning, sorting and grading.
- Understand shelling process and different material handling equipment.
- Understand the processing of various crops.

TEXT BOOKS:

1. Chakraverty, “A Post harvest technology for Cereals, Pulses and oilseeds”,

Oxford & IBH publication Pvt Ltd, New Delhi, Third Edition, 2000.

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

REFERENCE BOOKS:

1. Pande P H, “Principles of Agriculture Processing”, Kalyani Publishers, Ludhiana,1994.
2. Henderson, S.M. and Perry R.L, “Agricultural Process Engineering”, John Wiley and Sons, New York, 1955.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	1	2	3	3	3	1	3	-	3	1	3	1	2	2	1	3
2	-	-	2	1	1	1	3	1	1	2	3	1	3	2	1	3
3	-	-	2	2	1	1	3	3	1	3	2	2	3	1	3	-
4	-	1	1	2	2	3	3	2	-	2	3	-	2	1	2	3
5	2	3	1	-	3	1	3	1	2	2	-	-	3	1	3	1

1902508 OPERATION AND MAINTENANCE OF FARM MACHINERY L T P C

0 0 4 2

OBJECTIVES:

- The students will be introduced to the practice of different farm machinery in the field on tillage, sowing, plant protection, harvesting and threshing.
- The students will be familiar with the operation and maintenance, lubrication, fits and tolerances and replacements.
- To know the adjustments of farm machines, dismantling and reassembling of a disc harrow, seed-cum fertilizer drill and sprayer, engine pumps.
- To learn the field operations of farm machineries.
- To recognize the working principle of various machines used in field.

LIST OF EXPERIMENTS:

1. Identification of major systems of a tractor and general guidelines on preliminary check measures before starting a tractor - procedure for starting, running and stopping the tractor.
2. Identification of components of power tiller, their maintenance and study on preliminary check measures and safety aspects before starting a power tiller - procedure for starting, running and stopping the power tiller.
3. Field operation and adjustments of ploughs.
4. Field operation and adjustments of harrows.
5. Field operation and adjustments of cultivators.
6. Field operation of sowing and planting equipment and their adjustments.
7. Field operation of plant protection equipment.
8. Field operation on mowers and reapers.
9. Field operation of combine and determination of field losses.
10. Field operation of threshers and their performance valuation.
11. Studies on methods of repair, maintenance and off-season storage of farm equipment.
12. Opening and reassembly of disc harrows, determination and adjustment of tilt and disc angles.
13. Hitching of agricultural implements and trailers.
14. Study and operation of bulldozer.
15. Visit to agro-manufacturers.

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS REQUIRED:

1. Tractor – 1no.
2. Power tiller – 1no.
3. Disc plough – 1no.
4. Disc harrow – 1no.
5. Multi type cultivator – 1no.
6. Paddy Transplanter – 1no.
7. Seed drill – 1no.

8. Sprayer – 1no.
9. Mower – 1no.
10. Weeder -1no.
11. Combine harvester -1 no. (optional) – can be had as demonstration.

OUTCOMES:

- Helps students to start, run and stop the tractor.
- Students can identify the components of tiller.
- Hands on experience in field operation of ploughs, harrows, cultivators.
- Determination of field loss and adjustment of till and disc angles.
- Hitching the agricultural implements and studying the operation of bulldozer.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
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2	1	-	2	1	2	-	-	-	1	-	1	1	3	1	2	1
3	2	1	1	-	1	1	-	1	1	-	1	-	1	2	3	2
4	2	1	2	1	-	-	1	-	-	-	1	-	2	2	3	1
5	3	2	2	1	1	-	2	-	2	-	1	1	1	2	2	3

1902509 POST HARVEST ENGINEERING LABORATORY L T P C

0 0 4 2

OBJECTIVES:

- To determine various engineering properties of grains.
- To understand how to test and evaluate different post harvesting machineries.
- To get knowledge about evaluating the shelling efficiency of Agricultural materials.
- To visit industries working on post harvesting technologies.
- To evaluate the working efficiency of various agricultural machineries.

LIST OF EXPERIMENTS:

1. Determination of moisture content of grains by oven method and moisture meter.
2. Determination of porosity of grains.
3. Determination of coefficient of friction and angle of repose of grains.
4. Testing of paddy thresher & paddy winnower.
5. Testing of groundnut decorticator & maize sheller
6. Evaluation of thin layer drier.
7. Evaluation of L.S.U.drier.
8. Determining the efficiency of bucket elevator and screw conveyor.
9. Evaluation of shelling efficiency of rubber roll sheller.
10. Determining the oil content of oilseeds.
11. Visit to modern rice mill.
12. Visit to pulse milling industry.

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS REQUIRED:

1. Hot air oven, Grain moisture meter – 1 no.each.
2. Porosity apparatus – 1no.
3. Coefficient of friction apparatus – 1no.
4. Angle of repose – round type and L type – 1no.each.
5. Paddy thresher – 1no.

6. Groundnut decorticator and maize sheller – 1 no. each
7. Thin layer dryer – 1no.
8. LSU dryer – 1no.
9. Bucket elevator and screw conveyor – 1 no.each
10. Rubber rollsheller – 1no.
11. Oil expeller – 1no.

OUTCOMES:

- After the end of this lab, students will be able to determine various engineering properties of grains and its coefficients.
- Students are able to done the testing for the various Agricultural machinery of paddy, groundnut and maize.
- Evaluation of various agriculture machineries can be done by the students.
- Also getting the knowledge about the shelling efficiency and content of oil in the oil plants.
- Understanding the concepts of processing done in the various mills.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
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4	2	2	2	1	-	-	-	2	2	3	3	2	2	1	2	3
5	1	3	2	1	1	-	-	-	-	2	1	2	1	1	2	2

1902510 IRRIGATION FIELD LABORATORY L T P C

0 0 4 2

OBJECTIVES:

- Students should be able to study various Meteorological instruments.
- To practically determine the uniformity coefficient of the various irrigation systems.
- To study about the flow properties in open channels.
- To design various types of irrigation system.
- To understand the working principle of various instruments that is available in metrological Laboratory.

LIST OF EXPERIMENTS

1. To study various instruments in the Meteorological Laboratory.
2. Determination of infiltration rate using double ring and digital infiltrometer.
3. Determination of soil moisture wetting pattern for irrigation scheduling.
4. Design of Drip irrigation system.
5. Design of sprinkler irrigation system.
6. Measurement of flow properties in open irrigated channels (flumes, notches).
7. Evaluation of surface irrigation.
8. Determination of uniformity coefficient for drip irrigation system.
9. Determination of uniformity coefficient for sprinkler system (catch can method).
10. To conduct experiment on disc filter for micro irrigation systems.

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS REQUIRED:

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

OUTCOMES:

- On the completion of the course the student will have the knowledge on various meteorological instruments
- Having a practical knowledge of different irrigational systems.
- Evaluating the infiltration rate using various methods.
- Evaluating uniformity coefficient of the various irrigation systems.
- Measuring the flow in the channel and also conducting the experiment for micro irrigation system.

REFERENCE BOOKS:

1. Michael, A.M, "Irrigation Theory and Practice", Vikas Publishing House, New Delhi, 1999.
2. Asawa, G.L, "Irrigation Engineering", New Age International Private Limited, New Delhi, 1996.
3. Laboratory Manual, Centre for Water Resources, Anna University,Chennai.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	2	2	1	3	-	1	2	-	-	2	1	3	2	1	3	1
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4	2	2	2	1	-	-	-	2	2	3	3	2	2	1	2	3
5	1	3	2	1	1	-	-	-	-	2	1	2	1	1	2	2

1919002 PROFESSIONAL COMMUNICATION L T P C

0 0 2 1

OBJECTIVES:

The course aims to:

- Enhance the Employability and Career Skills of students.
- Orient the students towards grooming as a professional .
- To learn how to speak in Group Discussions.
- Make them employable Graduates and help them attend interviews successfully.
- Develop their confidence and help them to express views clearly.

UNIT-I: 6

English for competitive exams —General awareness of Current Affairs – multiple choice-Cloze – Vocabulary Structure.

UNIT-II: 6

Introduction to soft skills - Interpersonal communication - Introducing oneself to the audience —- answering questions – writing a message – memo –mail – asking for comments – giving information – agreeing to requests – apologizing – Complaining – Business proposal – short report – summarizing.

UNIT-III: 6

Introduction to Group Discussion— participating in group discussions –questioning and clarifying –GD strategies –monologues – dialogues – discussions.

UNIT-IV: **6**

Interview etiquette –Portfolio development- attending job interviews–FAQs related to job interviews- Interview types –expressing opinions – present circumstances - past experiences – future plans.

UNIT-V: **6**

Recognizing differences between groups and teams - networking professionally- respecting social protocols- understanding career management- developing a long- term career plan- making career changes. – organizing a larger unit of discourse – expressing and justifying opinions – negotiating – collaborating – disagreeing – speculating – decision taking.

TOTAL: 30 PERIODS

The lab course is offered as an **Employability Enhancement Course**

The course is offered as a **one credit** paper with an End Semester Examination.

OUTCOMES:

At the end of the course learners will be able to:

- Make effective presentations and participate confidently in Group Discussions
- Attend job interviews and interacting in different situations.
- Able to write business reports, proposals and related correspondence.
- Develop adequate Soft Skills required for the workplace

REFERENCE BOOKS:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students, Orient Balck Swan: Hyderabad, 2016.
3. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S. Hariharan et al., Soft Skills. MJP Publishers: Chennai, 2010.
6. Successful Presentations: DVD and Student's Book. A video series teaching business communication skills for adult professionals by John Huges and

Andrew Mallett- OUP 2012.

7. Goodheart-Willcox, "Professional Communication", First Edition , 2017. Online test book

8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 edition, 2015
9. English for success in Competitive exams. Philip Sunil Solomon – OUP 2009.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	3	3	-	-	-	-	3	-	1	2	1	1	1
2	3	2	2	2	2	-	3	-	-	2	-	1	2	2	2	1
3	3	2	-	3	-	-	-	-	-	3	-	1	1	1	1	-
4	3	3	-	-	-	-	3	-	-	3	-	1	2	-	1	-
5	3	2	3	-	-	-	-	-	-	3	-	1	2	2	2	1

SEMESTER VI

1902601 GROUNDWATER AND WELL ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To introduce the concepts of groundwater, its availability, assessment and utilization.
- To understand the theory behind well design, construction and management of wells.
- To gain knowledge about groundwater recharge and modeling techniques.
- To insist the importance of groundwater quality and recharge of the same.
- To predict the groundwater flow direction as an application of well hydraulics.

UNIT-I: HYDROGEOLOGIC PARAMETERS 9

Water Balance – Distribution of subsurface water – Water bearing properties of Rocks –

Types of Aquifers – Aquifer properties Estimation – Pumping test :– Permeability, Specific yield, transmissivity and Storage coefficient – Methods of Estimation – Ground water table fluctuation method – GEC Norms – Ground water development and potential in India - Groundwater prospective - Geophysical techniques – Electrical resistivity survey.

UNIT-II: WELL HYDRAULICS **9**

Darcy's law – Groundwater Flow Equation – Steady state flow – DupuitForcheimer Assumption – Theim's Equation - unsteady flow – Theis method and Jacob method – Image well theory – Partial penetration of wells.

UNIT-III: WELL DESIGN **9**

Design characteristics – Design of wells - Well diameter, depth and Well screen design – Materials for well screens – Well casing – Design of collector wells and Infiltration gallery – Dug wells versus tube wells.

UNIT-IV: WELL CONSTRUCTION AND MAINTENANCE **9**

Types of wells – Well drilling - Boring, Jetting – Rotary drilling, Hammer drilling - Construction – Installation of pipes and screens - Well development, Completion and disinfection – Well maintenance – Well performance test – Well effectiveness – Well loss – Pumping equipment – Rehabilitation of wells and borewells.

UNIT-V: SPECIAL TOPICS **9**

Artificial Recharge Techniques – Sea water Intrusion – Introduction to Ground water modeling Techniques – Ground water pollution and legislation - Groundwater quality – Dose response assessment – Risk analysis.

TOTAL: 45 PERIODS

OUTCOMES:

- Students know the technical aspects of groundwater, its availability, assessment and utilization.
- Understanding the basic concept about the well.

- Familiarized with the theory behind dunging and boring well design.
- Understanding the various concepts of well construction and maintenance.
- To gain knowledge about the seawater intrusion and groundwater quality.

TEXT BOOKS:

1. Karanth, K.R,"Groundwater Assessment, Development and Management", Tata Mc-Graw Hill,2008.
2. Raghunath, H.M,"Groundwater Hydrology", Wiley Eastern Ltd.,2000

REFERENCE BOOKS:

1. Rastogi A K, "Numerical Groundwater Hydrology", Penram International Publishing. Pvt. Ltd., Bombay,2008.
2. David Keith Todd, "Groundwater Hydrology", John Wiley & Sons, Inc.2007.
3. Fletcher.G.Driscoll, "Groundwater and Wells", Johnson Revision, New York,1987.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	2	3	3	2	3	1	1	-	-	2	3	2	-	2	3	1
2	3	2	2	2	-	-	1	1	2	1	3	3	1	-	1	1
3	3	3	3	3	2	-	-	-	2	2	2	3	1	2	-	1
4	3	3	3	2	1	1	1	-	2	-	2	1	2	1	2	-
5	2	3	3	2	3	1	1	-	-	2	3	2	-	2	3	1

1902602 FOOD AND DAIRY ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To introduce the students to dairy industry, properties and processing of milk, manufacture of dairy products, sanitation and effluent treatment in dairy industry.
- To expose the students to the fundamental knowledge of food, its properties and different methods of food processing.
- To gain knowledge about the food preserving and packing technology.
- To acquire better understanding of the food concentration and thermal

processing of foods.

- To gain knowledge on the theory, methods, and equipment for the various unit operations of dairy Industry.

UNIT-I: PROPERTIES AND PROCESSING OF MILK **9**

Dairy Industry - importance and status - Milk Types - Composition and properties of milk - Production of high quality milk - Method of raw milk procurement and preservation - Processing - Staining - Filtering and Clarification - cream separation – Pasteurization - Homogenization - sterilization, UHT processing and aseptic packaging -emulsification - Fortification.

UNIT-II: DAIRY PRODUCTS **9**

Manufacture of Milk Powder - Processing of Milk Products - Condensed Milk - Skim milk - Butter milk - Flavoured Milk, whey, casein, yoghurt and paneer - Manufacture of Butter - Cheese Ghee, ice creams and frozen desserts - standards for milk and milk products - Packaging of Milk and Milk Products - Cleaning and Sanitation - Dairy effluent treatment and disposal.

UNIT-III: FOOD AND ITS PROPERTIES, REACTION AND KINETICS **9**

Constituents of food - thermal processing of foods - cooking, blanching, sterilization, pasteurization, canning - Interaction of heat energy on food components, reaction kinetics, Arrhenius equation, TDT curves - water activity, sorption behaviour of foods – isotherm models - monolayer value, BET isotherms, Raoult' s law, Norrish, Ross, Salwin – Slawson equations.

UNIT-IV: PROCESSING AND PRESERVATION OF FOODS **9**

Coffee, Tea processing - Concentration of foods, freeze concentration - osmotic and reverse osmotic concentration - drying and dehydration of food - Tray, tunnel, belt, vacuum and freeze dryers - rehydration of dehydrated foods - Fat and oil processing, sources, extraction, methods and equipment, refining of oils, hydrogenation, manufacture of margarine - Food preservation methods - preservation by irradiation, microwave and dielectric heating of food.

UNIT-V: PACKAGING AND QUALITY CONTROL **9**

Food packaging, importance, flexible pouches - retort pouches - aseptic packaging, granules, powder and liquid packaging machines - nanotechnology - principles - applications in food processing - food plant location - Quality control of processed food products - Factors affecting quality.

TOTAL: 45 PERIODS

OUTCOMES:

- Knowledge about the properties and process of Milk.
- The students will gain knowledge about Dairy engineering and Food process.
- Understand the process of manufacturing of Dairy products.
- To gain knowledge about processing and preserving food like Coffee, Tea and Oil.
- Students will understand the importance of quality control,food preservation and packaging.

TEXT BOOKS:

1. Chandra GopalaRao,“Essentials of Food Process Engineering”, B.S. Publications, Hyderabad,2006.
2. Walstra P, Jan T. M. Wouter, Tom J. Geurts, “Dairy Science and Technology”, CRC press,2005.

REFERENCE BOOK:

1. Anantha krishnan, C.P, and Sinha, N.N, “Technology and Engineering of Dairy Plant Operations”, Laxmi Publications, New Delhi, 1999.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	-	1	-	2	3	-	-	1	-	3	1	2	1	3
2	1	1	-	2	1	1	3	-	-	2	2	3	1	1	2	3
3	-	-	-	1	1	3	3	2	-	1	2	1	2	1	2	1
4	1	-	1	-	1	3	2	-	1	2	3	1	3	2	2	3
5	1	-	2	1	3	3	3	1	-	-	2	2	1	1	2	1

1902603 PROTECTED CULTIVATION L T P C

3 0 0 3

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, vegetables and flower crops.
- To gain knowledge about precision technology and implementing it on farming activates.
- To learn and practice the various production practices of flower and other high value crops.
- To understand the disease management in the vegetable and flower crop.

UNIT-I: PROTECTED CULTIVATION AND ITS TYPES 9

Importance and methods of protected culture in horticultural crops - Importance and scope of protected cultivation – different growing structures of protected culture viz., green house, poly house, net house, poly tunnels, screen house, protected nursery house - study of environmental factors influencing 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: PROTECTED CULTIVATION OF VEGETABLE CROPS 9

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

UNIT-III: PROTECTED CULTIVATION OF FLOWER CROPS 9

Protected cultivation technology for flower crops - Hi-tech protected cultivation of cut

roses, cut chrysanthemum, carnation, gerbera, asiatic lilies, anthurium, orchids, cut foliages and fillers – integrated pest and disease management – postharvest handling.

UNIT-IV: PRECISION FARMING TECHNIQUES **9**

Concept and introduction of precision farming – Importance, definition, principles and concepts – Role of GIS and GPS - Mobile mapping system and its application in precision farming – design, layout and installation of drip and fertigation – georeferencing and photometric correction – Sensors for information gathering – UAV - geostatistics – robotics in horticulture - postharvest process management (PPM) – remote sensing.

UNIT-V: PRECISION FARMING OF HORTICULTURAL CROPS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

- Knowledge about the importance and types of productive cultivation.
- The students will be able to appreciate the different methods of protected cultivation practices available for vegetable crops and flowers.
- Understanding the disease management in the vegetable and flower crop.
- Introduction to precision farming techniques using GPS and GIS.
- A clear understanding of precision farming techniques and its application to horticultural crops.

TEXT BOOKS:

1. Joe.J.Hanan, “Green houses: Advanced Technology for Protected Horticulture”, CRC Press, LLC.Florida, 1998.
2. Paul V. Nelson, “Green house operation and management”, Ball publishing USA, 1991.

REFERENCE BOOKS:

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

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
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4	-	-	1	1	3	2	1	1	-	1	1	3	2	3	2	1
5	-	-	2	1	1	-	2	-	1	-	1	1	2	1	1	3

1902610 CAD FOR AGRICULTURAL ENGINEERING L T P C

0 0 4 2

OBJECTIVES:

- To design and draft the underground pipeline system
- To design and draft various ploughs.
- To design and draft post harvest technology units and bio gas plant.
- To introduce the students various 3D modeling Softwares.
- To design and draft Check dam.

LIST OF EXPERIMENTS:

1. Design and Drawing of Underground pipeline system.
2. Design and Drawing of Check dam.
3. Design and Drawing of Mould board plough.
4. Design and Drawing of Disk plough.
5. Design and Drawing of Post harvest technology units (threshers and winnowers).

6. Design and Drawing of Biogas plant.
7. Introduction & demonstration on 3D modeling softwares like Pro/E, Creo, Solid works, Solid Edge etc.

TOTAL: 60 PERIODS

OUTCOMES:

- The student will be able to understand the plan and layout of underground pipes.
- The students also will be able to design and draw the check dams
- The students also will be able to design and draw the various ploughs.
- The students also will be able to design and draw the post harvest units.
- The students also will be able to design and draw the bio gas plant.

REFERENCE BOOKS:

1. Michael, A.M, “Irrigation Theory and Practice”, Vikas Publishing House, New Delhi, 1999.
2. Rai, G.D, “Nonconventional Sources of Energy”, Khanna publishers, New Delhi, 1995.
3. Srivastava, A.C of Farm Ma, “Elements chinery”, Oxford and IBH Publications Co., New Delhi, 1990.
4. Vijay Duggal, “A general guide to Computer Aided Design & Drafting”, Mailmax Publications, 2000
5. TadeuszStolarski et al., “Engineering Analysis with ANSYS Software”, Butterworth Heinemann Publications,2006
6. Louis Gary Lamit, “Introduction to Pro/ENGINEER”, SDC Publications, 2004.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
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2	1	-	3	1	-	1	2	-	1	1	-	3	1	1	3	2
3	-	1	-	1	-	2	1	-	-	-	-	1	1	2	3	2
4	-	3	2	1	-	1	1	-	1	-	-	2	2	1	2	3
5	-	-	3	1	2	1	3	-	1	-	-	3	2	1	3	1

1902611 FOOD PROCESS ENGINEERING LABORATORY L T P C

0 0 4 2

OBJECTIVES:

- To get basic knowledge on various properties of food.
- To gets hand on experience on food process technology.
- To get knowledge on food adulteration.
- To determine the properties of various food materials.
- To visit food processing and dairy industry.

LIST OF EXPERIMENTS

1. Determination of cooking properties of parboiled and raw rice.
2. Estimation of microbial load in food materials.
3. Determination of rehydration ratio of dehydrated foods.
4. Experiment on osmotic dehydration of foods.
5. Experiment of food extruder.
6. Experiment on properties of food through microwave oven heating.
7. Determination of properties of milk.
8. Experiments on cream separator to determine the separation efficiency.
9. Experiments on construction and operation of butter churn and butter working accessories.
10. Experiments on detection of Food Adulteration.
11. Experiments on estimation of protein in food.
12. Experiment on expansion and Oil absorption characteristic of snacks on frying.
13. The lab includes visit to food processing and dairy industry

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS REQUIRED

1. Extruder-1no.
2. Pasteurizer – 1no.
3. Hot airoven-1no.
4. Hand refractometer-1no.

5. Dessicator-1no.
6. Dean and Stark‟ s apparatus -1no.
7. Cabinet dryer – 1no.
8. Soxhlet flask-1no.
9. Distillation column – 1no.
10. Kjeldahl flask –1no.
11. Distillation apparatus – 1no.
12. Microwave oven –1no.
13. Cream separator -1no.
14. Butter churner -1no.
15. Other basic requirements like weighing balance, physical balance, blotting papers, tracing sheets, burette, vernier calipers, pipette, conical flask, test tubes, beakers, spatula and other glasswares, food samples, chemicals should be available.

OUTCOMES:

- On completion of the lab course, the students will be able to get experience on various characteristics of food processing
- Will gain knowledge on determining cooking properties and rehydration ratio.
- Experimental knowledge about osmotic rehydration and food extruder.
- Knowledge about food adulteration.
- Will get hands on experience about various food processing tests.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Walstra, P. T.J. Geurts, A. Nooman, A. Jellema and M.A. J.S Van Boekel, “Dairy Technology”,Marcel Dekker Inc. Newyork, 2005.
2. Clunie Harvey, W.M and Harry Hill,“Milk Products”, 4th Edition Biotech Books,

New Delhi, 2009.

3. Robinson, R.K,“Modern dairy technology”, Vol.I Advances in Milk processing. Elsevier Applied Science Publishes, London, 1986.
4. Charm, S.E,“The fundamentals of Food engineering”, AVIpub.Co.,Inc,1971.
5. Karel Marcus, Fennama, R.Owen and Lund, B.Dayal, “Principles of food science”, Part II - Physical principles of food preservation, Marcel Dakker,Inc, 1975.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	-	-	2	1	1	1	1	-	-	1	-	3	3	2	3	3
2	-	1	1	-	1	-	1	-	-	-	-	2	-	1	2	1
3	-	-	1	-	1	1	2	-	-	-	-	2	1	-	2	2
4	-	-	3	2	1	2	2	-	-	1	1	3	3	3	3	1
5	-	-	1	2	1	2	2	-	-	1	1	2	3	3	2	1

1902612 **MINI PROJECT** **L T P C**

0 0 4 2

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports
- To train students to face reviews and viva voce examination.
- To guide the students to overcome the practical difficulties in their field of interest.
- To improve the presentation skills of students.

Students in a group of 3 or 4 shall work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on their views by the committee constituted

by the Head of the Department. The project work is evaluated based on oral presentation and the final project report jointly by a team of examiners including one external examiner.

OUTCOMES:

- On completion of the project work, students will be in a position to take up any challenging practical problems.
- To frame a methodology, with the help of literature review.
- To execute the project in correct sequence.
- To get hands on experience in writing report.
- To gain self confidence in presenting the project.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	1	2	3	1	2	2	1	-	3	3	2	2	3	3	3	3
2	2	2	2	2	1	1	-	-	3	2	2	3	1	3	3	2
3	-	1	3	3	2	1	1	-	3	1	2	2	-	2	2	1
4	-	-	-	2	3	2	-	-	2	2	1	2	3	2	2	2
5	-	-	-	-	2	1	-	-	2	3	1	3	1	2	3	1

SEMESTER VII

1902701 SOIL AND WATER CONSERVATION ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To present the concepts of erosion so that students get an idea about the problems associated with it.
- To have a sound knowledge about agronomic practices.
- To enable the students to make use of the principles and concepts to solve

issues related to soil and water management.

- To gain knowledge about water conservation measures.
- To expose students about sedimentation, its types, distribution patterns and also the methods to control them.

UNIT-I: SOIL EROSION PRINCIPLES **9**

Approaches to soil conservation – Soil conservation in India - Erosion – Agents - Causes - Mechanics of water erosion – Soil erosion problems - Types of water erosion: Raindrop erosion, Sheet erosion, Rill erosion, Gully erosion, Stream bank erosion – Classification of Gully – Gully Control Structures: Drop Spillway, Drop Inlet, Chute Spillways - Prerequisites for soil and water conservation measures.

UNIT-II: ESTIMATION OF SOIL EROSION **9**

Runoff computation for soil conservation: SCS-CN method – Evolution of Universal Soil Loss Equation: Applications and Limitations – Modified Universal Soil Loss Equation – Revised Universal Soil Loss Equation- Permissible erosion – Land use capability classification - Classification of eroded soils.

UNIT-III: EROSION CONTROL MEASURES **9**

Agronomic practices: contour cultivation - strip cropping – tillage practices – Soil management practices – Bunding: Types and design specifications - Mechanical measures for hill slopes – Terracing: Classification and design specification of bench terrace – Grassed waterways: Location, construction and maintenance – Types of temporary and permanent gully control structures.

UNIT-IV: WATERCONSERVATION MEASURES **9**

In-situ soil moisture conservation – Water harvesting principles and techniques: Micro catchments, catchment yield using morphometric analysis - Farm ponds: Components, Design, Construction and Protection – Check dams - Earthen dam – Retaining wall.

UNIT-V: SEDIMENTATION **9**

Sediment: Sources – Types of sediment load – Mechanics of sediment transport –

Estimation of bed load – Sediment Graph - Reservoir sedimentation: Basics - Factors affecting sediment distribution pattern, Rates of reservoir sedimentation - Silt Detention Tanks – sediment control methods.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to gain fundamental knowledge on the concepts of erosion and sedimentation.
- They will have sufficient knowledge on soil and water conservation measures.
- The students will be able to quantify the soil erosion.
- Students will have a brief knowledge on erosion control measures.
- To use conventional methods to determine sedimentation and to conserve water.

TEXT BOOKS:

1. Suresh, R., “Soil and Water Conservation Engineering”, Standard Publication, New Delhi, 2007.
2. Ghanshyam Das, “Hydrology and Soil Conservation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2000.
3. “Sedimentation Engineering”, 2006, ASCE manual and Report on Engineering Practice No. 54, Edited by Vito A. Vanoni. ASCE publishing.

REFERENCE BOOKS:

1. Murthy, V.V.N., “Land and Water Management Engineering”, Kalyani Publishers, Ludhiana, 1998.
2. Gurmail Singh, “A Manual on Soil and Water Conservation”, ICAR Publication, New Delhi, 1982.
3. Mal, B.C., “Introduction to Soil and Water Conservation Engineering”, Kalyani Publishers, New Delhi, 2002.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2					1					1			2	
2	1		2				2					1	1	1		
3	1	2	2				1						2		1	2
4		1	2									1		1	2	3
5				2								3	3	2		

1902702 REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM FOR AGRICULTURE ENGINEERS

L T P C
3 0 0 3

OBJECTIVES:

- To introduce the principles and basic concepts of Remote Sensing .
- To introduce the remote sensing systems, data products and analysis.
- To introduce about the basic concepts of GIS
- To introduce the spatial data models, analysis and presentation techniques.
- To gain knowledge about the application of Remote sensing and GIS in various fields.

UNIT-I: CONCEPTS OF REMOTE SENSING AND SATELLITES 9

Definition- Historical background - Components of remote sensing – Energy source, electromagnetic spectrum, radiation principle, platforms and sensors - Active and passive remote sensing interference - Atmospheric effects on remote sensing – Energy interaction with earth surface feature - Data acquisition - Reflectance, spectral signatures for water, soil and vegetation.- Satellites - Types - Sun synchronous - Geo synchronous remote sensing satellites - LANDSAT,SPOT & IRS - Resolution - Spectral, spatial, radiometric and Temporal resolution - Recent satellites with its applications.

UNIT-II: DATA PRODUCTS AND IMAGE ANALYSIS 9

Data products –based on level of processing- o/p – scale – area/coverage – data

availability – data ordering- data price - Image interpretation – Visual interpretation elements – interpretation key. Digital image processing – Image enhancement – image classification – Supervised and unsupervised – Vegetation Indices.

UNIT-III: CONCEPTS OF GIS **9**

Definition – Map and their influences – Characteristics of Maps – Elements – Map scale, Projection, Coordinate systems – Sources of spatial data – History and development of GIS – Definition – Components – Hardware and Software.

UNIT-IV: DATA INPUT AND ANALYSIS **9**

Data – Spatial, Non-Spatial – Database models – Hierarchical network, Relational and Object Oriented Data Models – Raster and Vector – Methods of Data input – Data Editing – Files and formats – Data structure – Data compression. Introduction to analysis – Measurements – Queries-Reclassification – Simple spatial analysis – Buffering – Neighboring functions – Map overlay – Vector and raster – Spatial interpolation – Modelling in GIS – Digital Elevation Modelling – Expert systems.

UNIT-V: APPLICATION OF RS AND GIS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

- The students will understand the remote sensing principles, remote sensing systems satellite data processing and available data products.
- They must know about the input required to run the software
- The students will understand decision making process using DBMS and utilization of these advanced techniques in addressing the real world problems.
- The applications of Remote Sensing and GIS in agriculture, soil and water

resources are understand with practical applications.

- Real-time crop water requirement is identified accurately.

TEXT BOOKS:

1. Anji Reddy. M, Remote Sensing and Geographical Information Systems, BS Publications, Hyderbad, 2001.
2. Lillesand, T. M., and Kiefer, R.W., Remote Sensing and Image Interpretation, John Wiley and Sons, New York, 2000.

REFERENCE BOOKS:

1. Bettinger,P., and Michael, G.W., "Geographical Information System: Applications in Forestry and Natural Resources Management," Tata McGraw–Hill Higher Education, New Delhi, 2003
2. Ian Heywood., "An Introduction to GIS", Pearson Education, New Delhi, 2001.
3. Jeffery Star and John Estes, "Geographical Information System – An Introduction," Prentice Hall India Pvt. Ltd., New Delhi, 1998.
4. Patel A.N & Surendra Singh, "Remote sensing principles & applications", Scientific Publishers, Jodhpur 1992.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	0	1	L2	1	2	3	4
1			1	2	3					2		1		2	1	
2		1			3	1				2			2			1
3	2	2									2		2	1		
4		3		2					1			2		1	2	
5	1		3	1	2		2					1			1	2

1902703 BIO - ENERGY RESOURCE TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To introduce about the fundamentals of Bio resource.
- To impart the fundamental knowledge on the importance of Bio energy and reactors.

- To expose students to the concepts of Alcohol and ethanol production.
- To understand the principles of Energy and Environment.
- To introduce the Principle of operation and environment impact analysis.

UNIT-I: BIO RESOURCE - AN INTRODUCTION` 9

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

UNIT-II: BIO ENERGY 9

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

UNIT-III: BIO REACTORS AND FERMENTORS 9

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

UNIT-IV: ALCOHOL PRODUCTION 9

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

UNIT-V: ENERGY AND ENVIRONMENT 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- The students will have a deep understanding on the bio resources.

- The students will gain knowledge on bio energy and appliances of Biogas.
- Students will impart knowledge on Bio Reactors and its impact on environment.
- The principles of thermo chemical conversion and its application is understood.
- Students have the brief knowledge on Energy and Environment.

TEXT BOOKS:

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

REFERENCE BOOK:

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

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1			1			1	3				2	1	2			2
2		2		1		1	2					1			2	1
3	1	2					1				1		1	1		
4				2							2	2	2	1		3
5	2					2	2					1		2	1	

1902707 **DESIGN AND DRAWING OF FARM AND IRRIGATION STRUCTURES**

L T P C
0 0 4 2

OBJECTIVES:

- To conceive and design various farm structures related to agricultural engineering.
- To conceive, design and draw the irrigation structures in detail showing the plan, elevation and sections.
- To gain knowledge about Diversion Head Works.
- To differentiate various cross drainage structures.

- To have knowledge on canal regulators.

UNIT-I: FARM STRUCTURES **15**

Design of poultry house - sheep / goat house- farm fencing system- farm trusses- ventilation system for dairy and poultry house.

UNIT-II: TANK COMPONENTS **15**

Fundamentals of design - Tank bunds – Tank surplus weirs – Tank sluice with tower head - Drawings showing foundation details, plan and elevation**.**

UNIT-III: CROSS DRAINAGE WORKS **15**

General design principles - Aqueducts – Syphon aqueducts – Super passage – Canal syphon – Drawing showing plan, elevation and foundation details.

UNIT-IV: CANAL REGULATION STRUCTURES **15**

General Principles - Canal head works –- Canal regulator – Canal escape – Drawing showing detailed plan, elevation and foundation details.

TOTAL: 60 PERIODS

OUTCOMES:

- The student can able to design and draw the plan, elevation and sections of tank components, farm structures, cross drainage works and canal regulation structures.
- The students are able to calculate the dimensions of irrigation structures.
- The students gain knowledge about importance of irrigation structures and their applications
- Students will gain understanding on the ground elevation available, with which they can choose the appropriate structure and design its components.
- To impart deep knowledge on the foundation design.

TEXT BOOKS:

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

1950."
2. Neubaur, L. W. and Walker, H.B. "Farm Buildings Design". Prentice Hall Inc., 1961.
3. Satya Narayana Murthy Challa, “Water Resources Engineering: Principles and Practice”, New Age International Publishers, New Delhi, 2002.
4. Garg, S.K., “Irrigation Engineering and Design of Structures”, New Age International Publishers, New Delhi, 1997.

REFERENCE BOOKS:

1. Mohanakrishnan. A, “A few Novel and Interesting Innovative Irrigation Structures: Conceived, Designed and Executed in the Plan Projects in Tamil Nadu”, Publ. No. 44 and Water Resources Development & Management Publ.No.43, IMTI Thuvakudy, Trichy, 2011.
2. Raghunath, H.M. “Irrigation Engineering”, Wiley India Pvt. Ltd., New Delhi, 2011.
3. Sharma R.K., “Irrigation Engineering and Hydraulic Structures”, Oxford and IBH Publishing Co., New Delhi, 2002.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	1	2	1	-	-	-	-	-	-	1	1	1	-	1	-
2	-	3	2	1	-	-	-	-	-	-	1	-	-	-	2	2
3	2	-	1	2	-	-	-	-	-	-	-	-	1	-	2	2
4	2	1	-	2	-	-	-	-	-	-	1	2	1	-	-	2
5	-	1	2	1	-	-	-	-	-	-	1	1	1	-	1	-

1902708 INTERNSHIP L T P C

0 0 0 1

OBJECTIVES:

- To train the students in field work by attaching to any industry / organization so as to have a firsthand knowledge of practical problems in Agricultural Engineering
- To gain working experience and skills in carrying out engineering tasks related to

various fields of agriculture.

- To know about the on-field requirement and to gain knowledge to bridge the gap between theoretical and practical.
- To have knowledge on report writing.
- To provide exposure to the students, to work as a team.

The students individually undertake training in reputed engineering companies / Govt organisations / NGOs / Educational Institutions who work in the area of Agricultural Engineering for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva- voce examination by a team of internal staff.

OUTCOMES:

- Gain practical knowledge by attaching themselves to the industry.
- Gain Hands on experience and skills in their specialization.
- To work efficiently as a team.
- To execute the theoretical concepts experimentally in field.
- At the completion of the training, students will be able to furnish a full report on the work done.

	PO												PSO			
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	2	2	1	-	-	-	-	3	-	1	2	2	1	2	2
2	3	1	1	2	-	-	-	-	2	-	2	3	3	2	1	2
3	2	2	2	1	-	-	-	-	3	2	-	2	2	1	1	2
4	3	3	3	2	-	-	-	-	-	-	1	1	2	1	2	1
5	-	1	1	1	-	-	-	-	1	1	-	2	2	1	1	2

1902709 **PROJECT WORK- Phase I** **L T P C**

0 0 4 2

OBJECTIVES:

- To develop the ability to solve specific problem.

- Students will be able to identify the problem and successfully find the solution with the help of literature review.
- To train the students in preparing project reports in standard format.
- Prepare students to face reviews and viva voce examination.
- To make them skilled by letting them doing their design requirement by themselves.

Students in a group of 3 or 4 shall work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on three reviews by the review committee constituted by the Head of the Department. The project work is evaluated based on oral presentation and the final project report jointly by a team of examiners including one external examiner.

OUTCOMES:

- On completion of the project work, students will be in a position to take up any challenging practical problems.
- To frame a methodology, with the help of literature review.
- To execute the project in correct sequence.
- To get hands on experience in writing report.
- To gain self confidence in presenting the project.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	2	2	1	-	-	-	-	3	-	1	2	2	1	2	2
2	3	1	1	2	-	-	-	-	2	-	2	3	3	2	1	2
3	2	2	2	1	-	-	-	-	3	2	-	2	2	1	1	2
4	3	3	3	2	-	-	-	-	-	-	1	1	2	1	2	1
5	-	1	1	1	-	-	-	-	1	1	-	2	2	1	1	2

SEMESTER VIII

1902808	PROJECT WORK - Phase II	L T P C 0 0 12 6

OBJECTIVES:

- To develop the ability to solve specific problem.
- Students will be able to identify the problem and successfully find the solution with the help of literature review.
- To train the students in preparing project reports in standard format.
- Prepare students to face reviews and viva voce examination.
- To make them skilled by letting them doing their design requirement by themselves.

Students in a group of 3 or 4 shall work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on three reviews by the review committee constituted by the Head of the Department. The project work is evaluated based on oral presentation and the final project report jointly by a team of examiners including one external examiner.

OUTCOMES:

- On completion of the project work, students will be in a position to take up any challenging practical problems.
- To frame a methodology, with the help of literature review.
- To execute the project in correct sequence.
- To get hands on experience in writing report.
- To gain self confidence in presenting the project.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	2	2	1	-	-	-	-	3	-	1	2	2	1	2	2
2	3	1	1	2	-	-	-	-	2	-	2	3	3	2	1	2
3	2	2	2	1	-	-	-	-	3	2	-	2	2	1	1	2
4	3	3	3	2	-	-	-	-	-	-	1	1	2	1	2	1
5	-	1	1	1	-	-	-	-	1	1	-	2	2	1	1	2

PROFESSIONAL ELECTIVE

SEMESTER V

ELECTIVE – I

1902504 SYSTEMS ANALYSIS AND SOFT COMPUTING IN AGRICULTURAL ENGINEERING **L T P C 3 0 0 3**

OBJECTIVES:

- To introduce the students to the application of systems concept to agricultural engineering problems, planning and management.
- Soft computing techniques for modeling different problems in the field agricultural engineering.
- To introduce the students to the operations research and linear programming.
- To provide the knowledge regarding simulation techniques.
- To introduce the students to areas of agricultural systems by using AI.

UNIT-I: SYSTEM CONCEPTS **9**

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

UNIT-II: LINEAR PROGRAMMING & DYNAMIC PROGRAMMING **9**

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

UNIT-III: SIMULATION **9**

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

UNIT-IV: NEURAL NETWORKS **9**

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

UNIT-V: FUZZY LOGIC AND GENETIC ALGORITHM 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the student will have the knowledge on system concepts and will be able to apply the optimization techniques like LP, DP, ANN, FL and GA for problems in agriculture.
- Understand and critically evaluate the scientific insights using linear programming and dynamic programming.
- To know about basic principles and concepts of simulation for irrigation scheduling.
- Critically evaluate the relative opportunities on NEURAL NETWORKS.
- After completion of this course, the students will be familiar with various Fuzzy set logic, Fuzzy Implications and Fuzzy algorithms.

TEXTBOOKS:

1. Vedula. S., and Majumdar, “P.P. Water Resources Systems – Modeling Techniques and Analysis”, Tata McGraw Hill, New Delhi, Fifth reprint, 2010.
2. Robert M Peart and W David Shoup, “Agricultural Systems Management – Optimizing efficiency and performance”, CRC Press, 2013.
3. Gupta. P.K., and Man Mohan, “Problems in Operations Research (Methods and Solutions)”, Sultan Chand and Sons, New Delhi, 1995.

REFERENCE BOOKS:

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

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	2	-	-	-	2	2	-	-	-	-	-	1	2	-	2	1
2	2	2	2	1	2	2	1	-	-	2	-	1	2	2	2	1
3	2	-	-	-	2	1	-	-	-	-	-	1	2	-	2	1
4	-	-	2	1	2	2	-	-	-	-	-	1	2	-	2	1
5	2	-	-	-	2	2	2	-	-	-	-	1	2	1	2	1

1902505 IT IN AGRICULTURAL SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To introduce the students to areas of agricultural systems in which IT and computers play a major role.
- To also expose the students to IT applications in precision farming, environmental control systems.
- To impart knowledge about agricultural systems management using IT application.
- To introduce the students about the climate change and predicting models.
- To introduce the students to E-GOVERNANCE in Agricultural Systems.

UNIT-I: PRECISION FARMING **9**

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

UNIT-II: ENVIRONMENT CONTROL SYSTEMS **9**

Artificial light systems, management of crop growth in greenhouses, simulation of CO_2 consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture.

UNIT-III: AGRICULTURAL SYSTEMS MANAGEMENT **9**

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

UNIT-IV: WEATHER PREDICTION MODELS **9**

Importance of climate variability and seasonal forecasting, Understanding and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts.

UNIT-V: E-GOVERNANCE IN AGRICULTURAL SYSTEMS **9**

Expert systems, decision support systems, Agricultural and biological databases, e-commerce, e- business systems & applications, Technology enhanced learning systems and solutions, e- learning, Rural development and information society.

TOTAL: 45 PERIODS

OUTCOMES:

- The students shall be able to understand the IT applications in precision farming.
- Upon completion of the course, the student will have the knowledge on environmental control systems.
- Students have a depth knowledge on Agricultural systems management.

- Students must able to understand about the weather prediction models.
- Gain the knowledge on the importance of E-Governance.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Peart. R.M., and Shoup, W. D., “Agricultural Systems Management”, Marcel Dekker, New York, 2004.
2. Hammer. G.L., Nicholls. N and Mitchell. C., “Applications of Seasonal Climate”, Springer, Germany, 2000.

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

1902506 CLIMATE CHANGE AND ADAPTATION L T P C

3 0 0 3

OBJECTIVES:

- To know the basics, importance of global warming.
- To introduce about the various components of Atmosphere.
- To know the concept of mitigation measures against global warming.
- To impart knowledge about the impact of climate change on Agriculture.
- To learn about the global warming and climate change.

UNIT-I: EARTH’S CLIMATE SYSTEM 9

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

UNIT-II: ATMOSPHERE AND ITS COMPONENTS **9**

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

UNIT-III: IMPACTS OF CLIMATE CHANGE **9**

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

UNIT-IV: OBSERVED CHANGES AND ITS CAUSES **9**

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

UNIT-V: CLIMATE CHANGE AND MITIGATION MEASURES **9**

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

Biomedical, Industrial waste – International and Regional cooperation.

TOTAL: 45 PERIODS

OUTCOMES:

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

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

TEXT BOOKS:

1. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007.

REFERENCE BOOKS:

1. “Adaptation and mitigation of climate change-Scientific Technical Analysis”, Cambridge University Press, Cambridge, 2006.
2. “Atmospheric Science”, J.M. Wallace and P.V. Hobbs, Elsevier / Academic Press, 2006.
3. Jan C. van Dam, “Impacts of Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press, 2003.

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

1902507 MICRO IRRIGATION L T P C

3 0 0 3

OBJECTIVES:

- To expose the students to the fundamental knowledge in Pumps for Irrigation use
- To introduce the concept of micro-irrigation its technology and economic values.
- To impart knowledge about the micro irrigation system design of Sprinkler & Drip irrigation system
- To learn about the role of irrigation water in agriculture, and the environmental factors that influence the type, frequency and duration of irrigation.
- To introduce the students about the management of the micro irrigation.

UNIT-I: WATER LIFTS AND PUMPS 9

Pump classification Variable displacement pumps – Centrifugal pump – Submersible pump – Vertical Turbine pumps mixed flow – Jet and Airlift pumps-Pump selection and installation – Pump troubles and Remedies.

UNIT-II: PUMP VALVES 9

Types of valves- Pressure relief valve- Gate valve-Isolated valve- Non return valve- Butterfly valve- Solenoid valves- Automated control valve- selection, repair and maintenance.

UNIT-III: MICRO IRRIGATION CONCEPT AND APPLICATIONS 9

Micro irrigation- Comparison between Traditional and Micro irrigation methods -Merits and demerits of micro-irrigation system, Types and components of micro irrigation system- Scope and potential problem of micro irrigation - Low cost Micro irrigation Technologies- Gravity fed micro irrigation -Care and maintenance of micro-irrigation System- Economics of micro-irrigation system - Automation in micro-irrigation-Surge and cablegation irrigation- Greenhouse irrigation system.

UNIT-IV: DRIP IRRIGATION DESIGN 9

Drip irrigation - Components- Dripper- types and equations governing flow through

drippers- Wetting pattern- Chemigation application- Pump capacity-Installation-Operation and maintenance of Drip irrigation system. - Design of surface and sub- surface drip irrigation.

UNIT-V: SPRINKLER IRRIGATION DESIGN **9**

Sprinkler irrigation- Components and accessories - Hydraulic design - Sprinkler selection and spacing- Capacity of sprinkler system - types - Sprinkler performance- Sprinkler discharge- Water distribution pattern- Droplet size, filtering unit, fertigation - System maintenance

TOTAL: 45 PERIODS

OUTCOMES:

- Categorize the different types of pumps and water lifting devices based on the principles, components and working efficiency.
- Students must get the knowledge about the pump valves.
- Establish water budget and hydraulics used to develop irrigation schedules through micro irrigation.
- Design drip including main line, sub-main and laterals design.
- Design sprinkler irrigation system, its components and capacity of sprinkler.

TEXT BOOKS:

1. Suresh, R., “Principles of Micro-Irrigation Engineering”, Standard Publishers Distributors, New Delhi, 2010.
2. Michael, A.M., “Irrigation Theory and Practice”, Vikas Publishers, New Delhi, 2002.

REFERENCE BOOKS:

1. Modi. P.N., and Seth. S.M., “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi, 1991.
2. Jack Keller and Rond Belisher., “Sprinkler and Trickle Irrigation”, Vannistr and Reinhold, New York, 1990.
3. Sivanappan R.K., “Sprinkler Irrigation”, Oxford and IBH Publishing Co., New Delhi, 1987.

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1905511 ENERGY AUDITING AND MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To acquaint and equip the students in energy auditing in industries and house hold sectors for increasing energy efficiency.
- To impart knowledge on energy management and facilitate application of energy conservation techniques in process industries.
- To impart knowledge on thermal and electrical utilities for evaluating energy saving potential.
- To familiarize on the trends in economics of energy use in various sectors and facilitate energy modeling to make policy decisions.
- To identify sources of energy loss and target savings.

UNIT-I: ENERGY CONSERVATION CONCEPTS 9

Energy – classification – scenario – energy pricing – energy and environment – energy conservation and its importance – energy strategy for the future – energy conservation act and its features.

UNIT-II: ENERGY AUDITING AND ECONOMICS 9

Scope of energy audit-– principles – energy audit strategy - types – detailed energy audit steps. Role of energy managers in industries; Energy performance - bench marking – fuel substitutions – energy audit instruments – material and energy balance – energy conversion – energy index – cost index – financial management – financing options.

UNIT-III: THERMAL ENERGY AUDIT **9**

Energy efficiency in thermal utilities – methodology – stoichiometric analysis of combustion in a boiler – performance evaluation – boiler losses - analysis – feed water treatment – energy conservation opportunities in boilers and steam system – furnaces – insulation and refractories – cogeneration – principles of operation - waste heat recovery systems – case study – analysis.

UNIT-IV: ELECTRICAL ENERGY AUDIT – I **9**

Electrical systems – introduction – electricity billing – load management – power factor – improvements and benefits – transformers – distribution losses – analysis – energy audit in electrical utilities methodology – energy conservation opportunities in motors – efficiency – energy efficient motors – motor losses – analysis – energy efficiency in compressed air system.

UNIT-V: ELECTRICAL ENERGY AUDIT – II **9**

HVAC and refrigeration system – fans and blowers – fan performance – pumps - lighting system - energy auditing and reporting in industries – replacement of renewable energy technology option – case study in agro-industries

TOTAL: 45 PERIODS

OUTCOMES:

- Acquire the knowledge on fundamentals of economic operation of an electrical system and understand the basic principles of energy auditing, types and objectives, instruments used.
- Develop procedures for conducting energy audit in different utilities in accordance with national and international energy regulations.
- Evaluate the performance of thermal utilities like furnace, boilers and steam distribution systems to improve efficiency
- Evaluate the performance of a electrical utilities like pumps, fans blowers to improve efficiency.
- Carryout performance assessment and suggest methods to improve the overall efficiency for different energy intensive industries.

TEXT BOOKS:

1. Guide books for National Certification Examination for Energy Managers and

Energy Auditors, Book 1, 2, 3 & 4. Bureau Energy Efficiency, New Delhi, 2005.

2. Murphy, W.R. and McKay, G. “Energy Management”, Butterworth & Co., Publishers Ltd., London, 1982.
3. Craig B. Smith, “Energy Management Principles, Applications, benefits & savings”. Pergamon Press Inc,1981.
4. Murgai, M.P. and Ram Chandra, “Progress in Energy Auditing and Conservation - Boiler Operations”, Wiley Eastern Ltd, 1990.

REFERENCE BOOKS:

1. Victor B.Ottaviano, “Energy Management”, An OTIS Publication, Ottaviano Technical Service Inc. 150. Broad Hollow Road, Melville, New York.,1747.
2. Richard Porter and Tim Roberts, “Energy saving by Waste recycling”, Elsevier applied science publishers, 1985.
3. Energy Management - Bi-monthly journal published by National Productivity Council, New Delhi.

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SEMESTER VI

ELECTIVE –II

1902604 AGRICULTURAL BUSINESS MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To introduce the importance of Agri-business management, its characteristics and principles.
- To introduce the students about Agriculture – Business Origination like staffing,

directing, supervision and motivation.

- To impart knowledge about the Agriculture financing regarding the acquiring capital budget analysis and financial management.
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.
- To learn about market promotion and human resources.

UNIT-I: CONCEPTS OF AGRICULTURAL BUSINESS 9

Agri-business - scope, characteristics, types. Management - importance, definition, management and administration, management thoughts, Small business - characteristics and stages of growth - Management functions - planning, organizing, leading.

UNIT-II: AGRI – BUSINESS ORGANIZATION 9

Principles, forms of agri-business organizations, staffing, directing, supervision and motivation. Controlling – types, performance evaluation and control techniques. Management approaches –Profit Centered Approach, Management by objectives and Quality Circles. Strength, Weakness, Opportunities and Threat (SWOT) Analysis.

UNIT-III: AGRICULTURAL MARKETING 9

Functional areas of Agri-business - Production and Operations management – functions, planning physical facilities and managing quality. Agro-inputs and products inventory management – raw material procurement, inventory types, and costs. Marketing management – Marketing environment, marketing mix – Agricultural input marketing firms.

UNIT-IV: AGRICULTURAL BUSINESS FINANCE 9

Forms of agri-business organizations – Role of lead bank in agribusiness finance - Financial management. Acquiring capital – Budget analysis. Concepts and determinants- Business project scheduling of raw material procurement - production management - launching products (branding, placement) - Input marketing promotion activities.

UNIT-V: MARKET PROMOTION AND HUMAN RESOURCES 9

Agricultural products - marketing promotion activities - product pricing methods. District Industries Centre - Consumer survey - Agricultural inputs retailing - Market potential assessment - types of distribution channels - Return on Investment - Personnel management. Recruitment, selection and training - Technology in Agri Business

TOTAL: 45 PERIODS

OUTCOMES:

- Students must able to understand the basic concepts of agricultural business.
- The students shall be exposed to various trends in agricultural business management.
- Students are able to get information about the functions, planning, physical facilities and managing quality.
- To form an agriculture business organization and to get advice from a lead bank.
- To know about the existing market strategy and to make marketing activities.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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4	-	-	-	-	2	-	-	-	-	-	3	1	2	-	1	3
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1902605 AGRICULTURAL ECONOMICS AND FARM MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

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

UNIT-I: FARM MANAGEMENT 9

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

UNIT-II: LAWS OF ECONOMICS 9

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

UNIT-III: COST CURVES **9**

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

UNIT-IV: MANAGEMENTOF RESOURCES **9**

Concept of risk and uncertainty – causes for uncertainty – Managerial decisions to reduce risks in production process – Management of resources – types of resources-

land, labour, capital and measurement of their efficiencies – Mobilization of farm resources- Cost of machinery and maintenance – Break even analysis – Investment analysis – Discounting techniques.

UNIT-V: FARM MANAGEMENT AND FINANCIAL ANALYSIS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

- Students are able to plan the financial aspects related to farm management in a cost effective manner.
- Understand the basic laws of economics.
- Compare the cost of multiple products and their relationship.
- Examine and evaluate the risk and uncertainty involved in management of resources.
- To gain knowledge on theory and methods of Farm management and financial analysis.

TEXT BOOKS:

1. Johl S.S., and Kapur, T.R., “Fundamentals of Farm Business Management”, Kalyani publishers, Ludhiana, 2007.
2. Subba Reddy S., Raghu Ram, P., Neelakanta Sastry T.V and Bhavani Devi I., “Agricultural Economics” Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.

REFERENCE BOOKS:

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

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4	1	1	-	1	2	1	-	-	-	-	2	1	1	-	1	1
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1915001 PROFESSIONAL ETHICS L T P C

3 0 0 3

OBJECTIVES:

- To introduce and educate the students on the concept of Human Values.
- To enable the students to have awareness on Engineering Ethics theories and models.
- To make students understand the code of ethics and fundamental principles in

social experiments in engineering.

- To educate on safety and risk aspects in engineering and to appreciate the rights of others.
- To create awareness about international issues related to ethics.

UNIT- I: HUMAN VALUES **9**

Moral values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Introduction to Yoga and Meditation for professional excellence and stress management - Simple Living and High Thinking, Science and Spirituality.

UNIT- II: ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of Professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT-III: ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters - Engineer's Responsibilities to Economically Deprived People and Environment, Corruption – Codes of Ethics- Fundamental Principles – A Balanced Outlook on Law – Challenger Case Study

UNIT -IV: SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk –Government Regulator's approach to risks - The Three Mile Island, Chernobyl & Bhopal Case Studies, Greenery Effects - Collegiality and Loyalty - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Unethical Behaviour at Work Place – Reporting Unethical Behaviour- Professional Rights – Employee Rights – Intellectual Property Rights (IPR).

UNIT – V: INTERNATIONAL ISSUES **9**

Multinational corporations - Business ethics - Environmental ethics - Internet ethics - Role in Technological Development - Weapons development-engineers as managers - Consulting Engineers - Engineers as expert witnesses and advisors - Honesty - leadership - Sample code of conduct ethics - ASME, ASCE, IEEE, Institution of Engineers (India),Indian Institute of Materials Management Institution of electronics and telecommunication engineers (IETE), India – Corporate Social Responsibility, Indian and Western Culture – Cyber Crime.

TOTAL: 45 PERIODS

OUTCOMES:

- Students should be able to understand human values and apply ethics in societal issues.
- Students will be able to get understanding on nuances of engineering ethics.
- Student will have an understanding of engineer's responsibility to society and code of ethics
- Students will understand risk and safety issues related to engineering.
- Students will be able to advocate on applying ethical principles in international context.

TEXT BOOKS:

1. World Community Service Centre, "Value Education", Vethathiri publications, Erode, 2011.
2. R. Subramanian, 'Professional Ethics' Oxford University Press, 2nd Edition 2017
3. R. S. Nagarazan, 'A Textbook on Professional Ethics and Human Values' New Age International Publishers, 2015
4. Sekhar, R.C., Ethical Choices in Business Response Books, New Delhi, Sage Publications,1997

REFERENCES:

1. Langford, Duncan (EDT): Internet Ethics, London, Macmillan Press Ltd., 2000.

2. Erwann, M. David, Michele S. Shauf, Computers, Ethics and Society, Oxford University Press,2003
3. Alan Kitson and Robert Campbell:" The Ethical Organisation", Red Globe Press, 2008.
4. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Professional Ethics and Human Values", Prentice Hall of India, New Delhi, 2013.
5. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 3rd edition (2017).

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1915003 TOTAL QUALITY MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To understand the need and evolution of quality concepts, contribution of quality gurus.
- To understand the TQM Principles and Models.
- To learn and apply the traditional tools and techniques of TQM.
- To educate students to apply the modern tools and techniques in TQM.
- To understand and apply QMS and EMS in any organization.

UNIT-I: INTRODUCTION 9

Introduction - Definition of quality - Need for quality - Evolution of quality - Dimensions of

product and service quality - Definition of TQM - Basic concepts of TQM – Principles of TQM - TQM Framework- Barriers to TQM – Benefits of TQM – Cost of Quality.

UNIT -II:TQM PRINCIPLES **9**

Leadership--The Deming Philosophy, Quality council, Quality statements and Strategic planning- Hoshin Planning - Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward - Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Sourcing, Supplier selection, Supplier Rating and Relationship development

UNIT -III: TQM TOOLS &TECHNIQUES I **9**

The seven traditional tools of quality – New management tools – Six-sigma Process Capability–Bench marking – Reasons to bench mark, Bench marking process, Criticisms of Bench Marking – FMEA –FMEA Documentation, Stages.

UNIT -IV:TQM TOOLS & TECHNIQUES II **9**

Quality Circles – Quality Function Deployment (QFD) – House of Quality – QFD Process, Benefits – Total Productive Maintenance – Concepts, Benefits – Business Process Reengineering – Concepts, Process and Applications – Business Process Improvement.

UNIT-V: QUALITY MANAGEMENT SYSTEM **9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation— Documentation—Internal Audits—Registration--Environmental Management System: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001 -Requirements of ISO 14001—Benefits of EMS – National and International Awards.

TOTAL: 45 PERIODS

OUTCOMES:

- Students would understand the basic concepts, contribution of quality guru's and TQM framework.
- Students would become acquainted with TQM Principles.
- Student would be able to apply the tools and techniques of quality management.
- Students will be able to apply Quality philosophy in business processes with an understanding on customer requirements.
- Students can apply QMS and EMS in any organisation.

TEXT BOOK:

1. Dale Besterfield, Carol B. Michna, Glen H. Besterfield, Mary B. Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal.R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,7 th Print 2011.
4. Itay Abuhav, ISO 9001: 2015 - A Complete Guide to Quality Management Systems, CRC Press; 1st edition (2017)
5. ISO 9001-2015 standard.

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1904606 INTELLECTUAL PROPERTY RIGHTS L T P C

3 0 0 3

OBJECTIVES:

- To give an idea about IPR, registration and its enforcement.
- To acquaint the students with basics of intellectual property rights with special reference to Indian Laws and its practices.
- To compare and contrast the different forms of intellectual property protection in terms of their key differences and similarities.
- To provide an overview of the statutory, procedural, and case law underlining these processes and their interplay with litigation.
- To encourage and protect innovation in the form of intellectual property rights

UNIT-I: INTRODUCTION 9

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

UNIT-II: REGISTRATION OF IPRs 9

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

UNIT-III: AGREEMENTS AND LEGISLATIONS 9

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

UNIT-IV: DIGITAL PRODUCTS AND LAW 8

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and

Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT-V: ENFORCEMENT OF IPRs **10**

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

TOTAL: 45 PERIODS

OUTCOMES:

- Skill to understand the concept of intellectual property rights.
- Develops procedural knowledge to Legal System and solving the problem relating to Intellectual property rights.
- Skill to pursue the professional programs in Company Secretary ship, Law Business (MBA), International Affairs, Public Administration and Other fields.
- Employability as the Compliance Officer, Public Relation Officer and Liaison Officer.
- Establishment of Legal Consultancy and service provider.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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4	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	-
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SEMESTER VI

ELECTIVE –III

1902607 AGRICULTURAL WASTE MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge to students on various methods of agricultural waste management for eco-friendly energy and manure production.
- To introduce the students about the composting and various methods.
- To insist the importance of agricultural waste management.
- To impart knowledge on effectively utilizing the agricultural waste.
- To impart the knowledge about producing the Bio products from Agricultural waste.

UNIT-I: INTRODUCTION 9

Availability of different types of agriculture wastes - its overall characteristics - classification of agro wastes based on their characteristics- its recycling and utilization potential - current constraints in collection and handling of agricultural wastes - its environmental impact.

UNIT-II: COMPOSTING 9

Definition- Solid waste suitable for composting – Methods of composting – vermicomposting – Mineralization process in composting - Biochemistry of composting – Factors involved – Infrastructure required – maturity parameters – value addition –

application methods.

UNIT-III: BIOMASS BRIQUETTING **9**

Definition – potential agro residues and their characteristics for briquetting – fundamental aspects and technologies involved in briquetting – economic analysis of briquetting – setting up of briquetting plant- appliances for biomass briquettes.

UNIT-IV: BIOCHAR PRODUCTION **9**

Definition - characteristics of agro wastes suitable for Biochar production – Methods of Biochar production – fast and slow pyrolysis – characteristics of Biochar – role of Biochar in soil nutrition and carbon sequestration.

UNIT-V: BIOGAS AND BIO ETHANOL PRODUCTION **9**

Screening of suitable lingo cellulosic substrate for biogas production -determination of bio-energy potential of agro-waste by estimating total solids - volatile solids - Calorific value- per cent total carbohydrates, moisture, lignin and cellulosic contents – preparation of feed stocks for anaerobic bio- digestion – types of digesters – factors affecting - nutrient value and utilization of biogas slurry. Ethanol production from lingo cellulosic wastes - Processing of Biomass to Ethanol – pre - treatment – fermentation – distillation.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of the course student will be able to understand various eco-friendly methods for agricultural waste management.
- Students gets the knowledge about vermicomposting
- Nutritive value and energy production potential of agro wastes.
- Gain knowledge about biochar product
- Students able to know about biogas and bio ethanol production.

TEXT BOOKS:

1. Raymond C Loehr, “Agricultural Waste Management - problems, processes and approaches”, First edition, Academic press, 1974.
2. Diaz,l.F.,M. de Bertoldi and W. Bidlingmaie, “Compost science and technology”, Elsevier pub., PP.1-380, 2007.
3. Uta Krogmann, Ina Körne and Luis F. Diaz., “Solid waste technology and management”, (Vol 1 and2). Blackwel Pub Ltd., Wiley Online library, 2010.
4. Yong Sik Ok, Sophie M. Uchimiya, Scott X. Chang, Nanthi Bolan*., “*Biochar-production characterization and applications”, 2015, CRC press.

REFERENCE BOOKS:

1. P.D. Grover & S.K. Mishra, “Biomass Briquetting: Technology and Practices”. Published by FAO Regional Wood Energy Development Programme in Asia, Bangkok, Thailand, 1996.
2. Magdalena Muradin and Zenon Foltynowicz, **“**Potential for Producing Biogas from Agricultural Waste in Rural Plants in Poland”. *Sustainability,* 2014, *6*, 5065- 5074.
3. “Biochar production from agricultural wastes via low-temperature microwave carbonization”.
4. Qian Kang, Lise Appels, Tianwei Tan and Raf Dewil, “Bioethanol from Lignocellulosic Biomass: Current Findings Determine Research Priorities” The Scientific World Journal, 2014, Article ID 298153, 13 pages.

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

1902608 SUSTAINABLE AGRICULTURE AND FOOD SECURITY L T P C

3 0 0 3

OBJECTIVES:

- To introduce the students about the importance of the land and water resources in India.
- 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.
- To study the impact of flood and drought in an ecosystem.
- To introduce about the various policies and programmers for sustainable management.

UNIT-I: LAND RESOURCE AND ITS SUSTAINABILITY 9

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

UNIT-II: WATER RESOURCE AND ITS SUSTAINABILITY 9

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

UNIT-III: SUSTAINABLE AGRICULTURE & ORGANIC FARMING 9

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

UNIT-IV: FOOD PRODUCTION ANDFOOD SECURITY 9

Performance of Major Food Crops over the past decades – trends in food production – Decline in total factor productivity growth – Demand and supply projections – Impact of

market force – Rural Land Market – Emerging Water market – Vertical farming -– Sustainable food security indicators and index – Indicator of sustainability of food Security – Path to sustainable development.

UNIT-V: POLICIES AND PROGRAMMES FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students will gain knowledge on the need for sustainable agriculture
- They will be able to comprehend the need for food security on global level and the Nutritional Security.
- The students will be able to demonstrate how ecological balance is required for sustainability of agriculture.
- Gain knowledge about food production and food security.
- Students must get an idea about food and crop production policies for sustainable growth.

TEXT BOOKS:

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.

REFERENCE BOOKS:

1. Swarna S.Vepa et. al., “Atlas of the sustainability of food security”, MSSRF, Chennai, 2004.
2. Sithamparanathan, J., Rengasamy, A., Arunachalam, N. “Ecosystem principles and sustainable agriculture”, Scitech Publications, Chennai, 1999.

3. Gangadhar Banerjee and Srijeet Banerji, “Economics of sustainable agriculture and alternate production systems”, Ane Books Pvt Ltd., 2017
4. M.S.Swaminathan, “Science and sustainable food security”, World Scientific Publishing Co.,Singapore, 2010.

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4	1	2	-	-	1	1	2	-	-	-	-	-	1	-	-	1
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1909612 REFRIGERATION AND AIR CONDITIONING FOR AGRICULTURAL ENGINEERS **L T P C 3 0 0 3**

(Steam and Refrigeration table with Psychrometry Chart is permitted in University Examination)

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Review the thermodynamic principles of refrigeration.
- Understand the operation of the system components and refrigerants.
- Analyze the psychrometric processes.
- Analyze the load calculation of air conditioning systems.
- Apply the refrigeration cycles in various plants

UNIT-I: REFRIGERATION CYCLE **9**

Review of thermodynamic principles of refrigeration. Concept of Air refrigeration system. Vapour compression refrigeration cycle – use of P.H charts – multistage and multiple evaporator systems-cascade system – COP comparison.

UNIT-II: REFRIGERANTS, SYSTEM COMPONENTS AND BALANCING **9**

Compressors – reciprocating & rotary (elementary treatment) – condensers –

evaporators cooling towers. Refrigerants – Properties – selection of refrigerants, Alternative refrigerants, cycle controls.

UNIT-III: PSYCHROMETRY **9**

Psychrometric processes use of psychrometric charts – grand and room sensible heat factors – bypass factors – air washers, requirements of comfort air conditioning, summer and winter air conditioning.

UNIT-IV: AIR CONDITIONING SYSTEMS **9**

Cooling load calculation working principles of – centralized Air conditioning systems, split, ductable split, packaged air conditioning, VAV & VRV systems. Duct design by equal friction method, indoor air quality concepts.

UNIT-V: UNCONVENTIONAL REFRIGERATION CYCLES **9**

Vapor absorption systems – Ejector jet, steam jet refrigeration, thermo electric refrigeration. Applications: ice – plant – food storage plants – milk chilling plants.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Review the thermodynamic principles of refrigeration.
- Understand the operation of the system components and refrigerants.
- Analyze the psychrometric processes.
- Analyze the load calculation of air conditioning systems.
- Apply the refrigeration cycles in various plants

TEXT BOOKS:

1. Manohar Prasad, “Refrigeration and Air Conditioning”, Wiley Eastern Ltd., New Delhi, 1983.
2. Arora, C.P., “Refrigeration and Air Conditioning”, Tata McGraw Hill, New Delhi, 1988.

REFERENCE BOOKS:

1. Dossat, R.J., “Principles of Refrigeration and Air Conditioning”, Pearson Education Pvt.
   Ltd., New Delhi, 1997.
2. Jordon and Priester, “Refrigeration and Air Conditioning”, Prentice Hall of India Pvt. Ltd., New Delhi,1985.
3. Stoecker, N.F., and Jones, “Refrigeration and Air Conditioning”, Tata McGraw Hill, New Delhi,1981.

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1902609 SEED PROCESSING TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To expose the students to scope and importance of good quality seed production.
- To acquaint them with the principles and special techniques used in the process of production of good quality seed using specific examples.
- To introduce about the various testing process used to find the quality of seeds.
- To familiarize students with planning, development and organization of seed programmes.
- To impart knowledge about the seed preparation for a particular crop.

UNIT-I: SEED CHARACTERS 9

Definition and characteristics of seed and how it differs from grain- Propagation of crop plants through true seed and vegetative means- Features of good quality seed- Importance of seed in successful crop production- Floral biology: self and cross

pollination- Methods of genetic improvement of crop plants such as selection, hybridization, mutation and polyploidy- Seed legislations promulgated in India from 1966 to date and the purpose of each of these legislations.

UNIT-II: SEED PRODUCTION AND CERTIFICATION 9

Multiplication of seed and seed material: systems of seed multiplication, classes of seed, multiplication models, multiplication ratio, field selection, planting ratio, isolation needs and rouging- Harvest and extraction of seed- Methods of hybrid seed production- Genetic deterioration during crop production cycles- Seed certification process: legal basis, pre-requisites for applicability, detailed description of the specific steps of the certification process (with particular emphasis on field inspection).

UNIT-III: SEED PROCESSING AND TESTING 9

Components of seed processing in a broader sense- Steps in seed processing in its narrower sense: preliminary cleaning, basic cleaning and grading, and equipment used in each of the steps- Seed treatment- Seed drying- Seed sampling- Seed testing: details of specific tests conducted for different purposes (service, certification and seed law enforcement)- Standards prescribed for different crops.

UNIT-IV: DEVELOPING SEED PROGRAMMES 9

Types of organizations involved in seed production (public, quasi-governmental, private and cooperative), and their objectives and features- Organizational set up of a seed company- Steps involved in planning and developing a seed programme- Seed marketing activities, and analysis of seed demand and supply- Costing and pricing strategies- Economics of production of different crop seed- Seed packaging- Opportunities for Indian seed companies to have a greater share of world seed market- Visit to seed organizations- Preparing seed projects to obtain credit- Export procedures and formalities- Seed/plant quarantine methods.

UNIT-V: SEED PRODUCTION IN SPECIFIC CROPS 9

Principles and special techniques used for seed production in important horticultural crops by selecting representatives of vegetable / flower / fruit / spice / condiment / plantation crops.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the different varieties and qualities of seeds.
- Students must understand the need for seed production and certification.
- The students will be able to appreciate the different methods of seed production, processing and testing.
- They will also have the knowledge on different seed programmes.
- Students know about the special technique in horticulture production.

TEXT BOOKS:

1. Singh. S.P, “Commercial Vegetable Seed Production”, Kalyani Publishers, Chennai, 2001.
2. Agarwal. R.L., “Seed Technology”, Oxford IBH Publishing Co,New Delhi, 1995.

REFERENCE BOOKS:

1. Subir Sen and Ghosh. N., “Seed Science”, Kalyani Publishers, Chennai, 1999.
2. Dahiya. B.S. and Rai. K.N., “Seed Technology”, Kalyani Publishers, Chennai, 1997.
3. George, Raymond. A.T., “Vegetable Seed Production”, Longman Orient Press, London and New York, 1985.
4. “Hand Book of Seedling Evaluation”, ISTA, 1979.

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

1903612 DISASTER MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

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

UNIT-I: INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT-II: APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake- holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT-III: INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects

such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT-IV: DISASTER RISK MANAGEMENT IN INDIA **9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT-V: DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to:

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess factors of vulnerability and its impact.
- Knowledge of various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context.
- Disaster damage assessment and management.

TEXT BOOKS:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13:978-9380386423

2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13:978-1259007361.
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011.
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCE BOOKS:

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.

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SEMESTER VII

ELECTIVE –IV

1902704 STORAGE AND PACKAGING TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To understand the underlying principles of spoilage and storage
- To provide knowledge on different storage methods and packaging techniques.
- To learn testing of different food packaging materials.
- To understand various maintenance of CA storage facilities.

- To provide knowledge about losses in storage and to estimate the losses.

UNIT-I: SPOILAGE AND STORAGE **9**

Direct damages, Indirect damages of perishable and durable commodities – control measures - factors affecting storage – types of storage – Losses in storage and estimation of losses.

UNIT-II: STORAGE METHODS **9**

Improved storage methods for grain-modern storage structures-infestation-temperature and moisture changes in storage structures-CAP storage-CA storage of grains and perishables construction operation and maintenance of CA storage facilities.

UNIT-III: FUNCTIONS OF PACKAGING MATERIALS **9**

Introduction – packaging strategies for various environment – functions of package – packaging materials – cushioning materials – bio degradable packaging materials – shrink and stretch packaging materials.

UNIT-IV: FOOD PACKAGING MATERIALS AND TESTING **9**

Introduction – paper and paper boards - flexible - plastics - glass containers – cans – aluminium foils - package material testing-tensile, bursting and tear strength.

UNIT-V: SPECIAL PACKAGING TECHNIQUES **9**

Vacuum and gas packaging - aseptic packaging - retort pouching – edible film packaging – tetra packaging – antimicrobial packaging – shrinks and stretches packaging.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will have a clear understanding of various methods of storage and different packaging techniques for food.
- The students will gain knowledge on different materials that can be used for food

- packaging.

- At the end of this course, the students will be thorough in testing of packaging materials.
- The students will be able to enlist the functions of various packaging materials.
- The students will learn about the special packaging techniques.

TEXT BOOKS:

1. Sahay, K.M. and K.K.Singh, “Unit operations of agricultural processing”, Vikas Publishing House Pvt. Ltd., New Delhi,1996
2. Food Packaging Technology Hand book, NIIR Board, New Delhi ,2004.
3. Pandey, P.H, “Post harvest engineering of horticultural crops through objectives”, Saroj Prakasam, Allahabad, 2002.

REFERENCE BOOKS:

1. Himangshu Barman and Jodhpurs Chakaraverty, “A Post Harvest Food grain storage Agrobios” (India), 3rd edition, 2008.
2. “Post harvest technology of cereals, pulses and oil seeds”. Oxford & IBH publishing & Co.Pvt.Ltd, New Delhi.

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1909717 HEAT AND MASS TRANSFER FOR AGRICULTURAL ENGINEERS

L T P C
3 0 0 3

(Heat and Mass Transfer Data Book Permitted in the University Examination)

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Apply the principle mechanism of heat transfer under steady state and transient conditions.
- Apply the fundamental concept and principles in convective heat transfer
- Apply the theory of phase change heat transfer and design of heat exchangers.
- Apply the fundamental concept and principles in radiation heat transfer.
- Analyze the relation between heat and mass transfer and to solve simple mass transfer problems.

UNIT-I: CONDUCTION **9**

Basic concepts – Mechanism of heat transfer – Conduction, convection and radiation – General differential equation of heat conduction – Fourier law of conduction – Cartesian and cylindrical coordinates – one dimensional steady state heat conduction – Conduction through plane walls, cylinders and spherical systems – Composite systems – Conduction with internal heat generation- Extended surfaces – Unsteady heat conduction – Lumped analysis – Use of Heislers chart.

UNIT-II: CONVECTION **9**

Basic concepts – Convective heat transfer coefficients – Boundary Layer concept – Types of convection – Forced convection – Dimensional analysis – External flow – Flow over plates, Cylinders and spheres – Internal flow – Laminar and turbulent flow – Combined Laminar and turbulent flow – Flow over bank of tubes – Free convection – Dimensional analysis – Flow over vertical plates, horizontal plate, inclined plate, cylinders and spheres.

UNIT-III: PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS **9**

Nusselts theory of condensation – Pool boiling, flow boiling, correlations in boiling and condensation, types of heat exchangers – LMTD method of heat exchanger analysis – Overall heat transfer coefficient – Fouling Factors.

UNIT-IV: RADIATION **9**

Basic concepts, law of radiation – Stefan Boltsmann law, Kirchoff law – Block body radiation – Grey body radiation shape factor algebra – Electrical analogy – Radiation shields – introduction to gas radiation.

UNIT-V: MASS TRANSFER **9**

Basic concepts – Diffusion mass transfer – Fick's Law of diffusion – Steady state molecular diffusion – Convective mass transfer – Momentum, heat and mass transfer analogy – Convective mass transfer correlations.

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Apply the principle mechanism of heat transfer under steady state and transient conditions.
- Apply the fundamental concept and principles in convective heat transfer
- Apply the theory of phase change heat transfer and design of heat exchangers.
- Apply the fundamental concept and principles in radiation heat transfer.
- Analyze the relation between heat and mass transfer and to solve simple mass transfer problems.

TEXT BOOKS:

1. Sachdeva, R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age International, New Delhi, 1995.
2. Yadav, R., "Heat and Mass Transfer", Central Publishing House, New Delhi**,** 1995.

REFERENCE BOOKS:

1. Nag, P.K., "Heat Transfer", Tata McGraw Hill Book Co., New Delhi**,** 2002.
2. Holman, J.P., Heat and Mass transfer, Tata McGraw Hill Book Co., New York, 2002.

3. Kothandaraman, C.P., “Fundamentals of Engineering Heat and Mass Transfer”,New Age International, New Delhi, 1998.
4. Incropera, F. P., and Dewitt, D. P., “Fundamentals of Engineering Heat and Mass Transfer”, John Wiley and Sons, New York, 1998.
5. Ozisik, M.H., “Heat Transfer”, McGraw Hill Book Co., New York, 1994.

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1902705 PROCESS ENGINEERING OF FRUITS AND VEGETABLES

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OBJECTIVES:

- To understand the basics of Post Harvest Technology of fruits and vegetables through their structure and composition
- To study the different methods of processing and preservation of fruits and vegetables including drying and dehydration.
- To learn the latest methods of storage of fruits and vegetables.
- To Gain knowledge on the importance of cleaning.
- To expose students to the concept of On-Farm processing of fruits and vegetables.

UNIT-I: STRUCTURE, COMPOSITION, RIPENING AND SPOILAGE 9

Importance of post harvest technology of horticultural crops – post harvest losses – factors causing losses – structure, cellular components, composition and nutritive value

of horticultural crops – fruit ripening – mechanism and equipment – spoilage of perishable commodities – mechanism and factors causing spoilage.

UNIT-II: CLEANING, GRADING AND ON-FARM PROCESSING 9

Harvesting and washing of fruits and vegetables – cleaning and grading – fruits and vegetables – peeling – equipments – construction and working – pre-cooling – importance, methods, pretreatments and advantages.

UNIT-III: PRESERVATION OF FRUITS AND VEGETABLES 9

Thermal and non-thermal techniques of preservation of fruits and vegetables and their products – methods – minimal processing of horticultural commodities – fruits and vegetables, advantages – quick freezing preservation – commercial canning of fruits, vegetables and other perishable commodities – processing and concentration of juice – membrane separation process and application – hurdle technology of preservation and techniques.

UNIT-IV: DRYING AND DEHYDRATION 9

Dehydration of fruits and vegetables – types of dryers, construction and working – methods – fluidized bed dryer, freeze drying, osmotic dehydration and foam mat drying – principles, construction, operation and applications – quality parameters and advantages.

UNIT-V: STORAGE 9

Storage of fruits and vegetables – storage under ambient conditions, low temperature storage, evaporative cooling – cold storage of horticultural commodities – estimation of cooling load – controlled atmosphere storage – concept and methods – modified atmosphere packaging – gas composition, quality of storage – waxing of fruits – types of wax, equipment and advantages

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course, the student will be thorough in various methods of

processing, preservation and storage of fruits and vegetables using latest technologies.

- The students will understand the Importance of post harvest technology of horticultural crops.
- The students will be able to do cleaning, grading and on-farm processing of fruits and vegetables.
- The students will learn principles, construction, operation and applications of dehydration.
- The students will be thorough in storage methods of fruits and vegetables.

TEXT BOOKS:

1. Fellows. P. “Food Processing Technology – Principles and Practice”, Second edition, CRC Press, Woodland Publishing Limited, Cambridge, England,2000.
2. Sudheer K. P. and V. Indra, “Post harvest Technology of Horticultural Crops”, New India Publishing Company, New Delhi, 2007.
3. L.R.Verma and V.K.Joshi “Post Harvest Technology of Fruits and Vegetables – handling, Processing, Fermentation and waste management”, Indus Publishing company, New Delhi,2000.

REFERENCE BOOKS:

1. Heid,J.L. and M.A.Joslyn, “Food processing operations”. Vol. II. AVI Publishing Co. Inc. Westport, Connecticut,1983.
2. Potter, N.N.1976. Food science. AVI Publishing Co. Inc.Westport, Connecticut, 2nd edition.
3. Sivetz Michael and N.W.Desrosier, Coffee Technology. AVI Publishing Co. Inc. Westport, Connecticut.
4. Frank.H.Slade. 1967. Food Processing Plant. Volume 1. Leonard Hill Books. London.
5. SudhirGupta.Cold storage unit. Atif printers, LalKuan, Delhi.
6. NIIR board. Modern techniques on food preservation. Asia pacific business press Inc. Delhi.
7. Humberto vega and Gustavo v Barbosa. 1996. Dehydration of foods. Springer Science, Business Media, Chapman&Hall Publishers, U.K.

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1902706 **FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT** **L T P C 3 0 0 3**

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services.
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems.
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification.
- To gain knowledge on modelling software.
- To expose students to concept of maintenance and repair.

UNIT-I: FUNDAMENTALS OF PRODUCT DEVELOPMENT **9**

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies- Product Life Cycle – Product Development Planning and Management.

UNIT-II: REQUIREMENTS AND SYSTEM DESIGN **9**

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT-III: DESIGN AND TESTING **9**

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation.

UNIT-IV: SUSTENANCE ENGINEERING **9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal.

UNIT-V: BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY **9**

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the students will be able to:
- Define, formulate and analyze a problem.
- Solve specific problems independently or as part of a team.
- Gain knowledge of the Innovation & Product Development process in the Business Content.
- Understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics.
- Develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer.

TEXT BOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCE BOOKS:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.

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SEMESTER VIII

ELECTIVE –V

1902801 WATERSHED MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To provide the technical know-how of analyzing the degradation of soil and water resources and implementation of the measures for soil and water conservation.
- To provide a comprehensive treatise on the engineering practices of watershed management for realizing the higher benefits of watershed management.
- To understand the importance of water conservation practices.
- To gain knowledge on Monitoring and evaluation system.
- To expose students to the concept of Groundwater Recharge and its importance.

UNIT-I: INTRODUCTION 9

Watershed – Definition - concept - Objectives – Land capability classification - priority watersheds- land resource regions in India

UNIT-II: WATERSHED PLANNING 9

Planning principles – collection of data – present land use - Preparation of watershed development plan – Estimation of costs and benefits – Financial plan – selection of implementation agency – Monitoring and evaluation system.

UNIT-III: WATERSHED MANAGEMENT 9

Participatory watershed Management - run off management - Factors affecting runoff - Temporary & Permanent gully control measures - Water conservation practices in irrigated lands - Soil and moisture conservation practices in dry lands.

UNIT-IV: WATER CONSERVATION PRACTICES **9**

In-situ & Ex-situ moisture conservation principle and practices - Afforestation principle - Micro catchment water harvesting - Ground water recharge – percolation ponds -Water harvesting - Farm pond - Supplemental irrigation - Evaporation suppression - Seepage reduction.

UNIT-V: WATERSHED DEVELOPMENT PROGRAMME **9**

River Valley Project (RVP) - Hill Area Development Programme (HADP) - National Watershed Development Programme for Rainfed Agriculture (NWDPRA) - Other similar projects operated in India – Govt. of India guidelines on watershed development programme - Watershed based rural development – infrastructure development - Use of Aerial photography and Remote sensing in watershed management - Role of NGOs in watershed development

TOTAL: 45 PERIODS

OUTCOMES:

- After completion of the course, the students will have a thorough knowledge on watershed planning.
- The students will learn development and management strategies through different soil and water conservation approaches.
- The students will gain knowledge about watershed development programme.
- The students will understand the water conservation practices and its importance.
- The students will be provided with a comprehensive treatise on the engineering practices of watershed management for realizing the higher benefits of watershed management.

TEXT BOOKS:

1. Suresh, R. 2005. Soil and Water Conservation Engineering, Standard Publishers & Distributors, New Delhi.
2. Ghanashyam Das, “Hydrology and Soil Conservation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2000.

REFERENCE BOOKS:

1. Gurmel Singh et al. 2004. Manual of soil and water conservation practices, Oxford & IBH publishing Co. New Delhi.
2. Suresh, R. 2008. Land and water management principles, Standard Publishers& Distributors, New Delhi.
3. Murthy, V.V.N. 2005, Land and water management, Kalyani publishing, New Delhi.

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1902802 ON FARM WATER MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To understand the fundamentals of minor irrigation, its types, operation and maintenance and people's participation.
- To learn Command Area Development, On farm structures, policy, operation and maintenance.
- To understand various practices of water management on farm.
- To gain knowledge on water requirement and utilization.
- To expose students to the concept of water Requierment of crops.

UNIT-I: DESIGN OF IRRIGATION CHANNELS 9

Design of Erodible and Non-Erodible, Alluvial channels- Kennedy's and Lacey's

Theories - Materials for Lining watercourses and field channel - Water control and Diversion structure - Design - Land grading - Land Leveling methods.

UNIT-II: COMMAND AREA **9**

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

UNIT-III: CONJUNCTIVE USE OF SURFACE AND GROUNDWATER **9**

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

UNIT-IV: WATER BALANCE **9**

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

UNIT-V: SPECIAL TOPICS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

- The students will have a clear understanding of various practices of water management on farm.
- The students will gain knowledge on Command Area Development.
- The students will be able to summarize conjunctive use of surface and groundwater.
- The students will have a clear understanding of Groundwater balance model.
- The students will be taught with National water policy and Institutional aspects of

on farm water management.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Keller, .J. and Bliesner D.Ron, 200, “Sprinkler and Trickle irrigation” , An Ari Book, Published by Van No strand Rein hold New York.
2. Israelson, “Irrigation principles and practices”, John Wiley & sons, New York.
3. Modi, P.N., 2002, “Irrigation and water resources and water power engineering”, Standard Book House, New Delhi.
4. Michael, A.M. and Ojha, T.P. 2002, “Principles of Agricultural Engineering- Vol II”, Jain Brothers, New Delhi.
5. Suresh, R. 2008, “Land and water management principles”, Standard Publishers & Distributors, New Delhi.

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1902803 **AUTOMATION IN IRRIGATION** **L T P C**

3 0 0 3

OBJECTIVES:

- To expose the students to the concept of Irrigation Automation.
- To introduce the concepts of Automatic Systems and IoT applications.
- To train the students to explore and use new technologies in Irrigation.
- To gain knowledge on the Economic Impacts of Automation on Agricultural Firms
- To expose students to the concept of surface and sub-surface Automation.

UNIT-I: INTRODUCTION TO AUTOMATION **9**

Automatic Irrigation – Traditional methods of Irrigation – Need for Automation – Comparison between Traditional and Automated Irrigation – Advantages – Disadvantages – Economic Impacts of Automation on Agricultural Firms – Future of Automation.

UNIT-II: SYSTEMS OF AUTOMATION **9**

Automated Irrigation – Pneumatic System – Portable timer system – Timer/Sensor Hybrid/SCADA- Methods of automating Irrigation layout – Machine Learning in Tank Monitoring System.

UNIT-III: IoT IN IRRIGATION **9**

IoT based Automated Irrigation System – IoT based Smart Irrigation – Sensor based Automation – types – operation – Solar based Automatic Irrigation System – components – operation - Automation by sensing soil moisture – Automation using ANN based controller – operation.

UNIT-IV: SURFACE AND MICRO-IRRIGATION AUTOMATION **9**

Automation and control in Surface Irrigation Systems – Equipments – benefits – barriers – Automation Design in Bay, Basin and Furrow Irrigation – Automation in Micro Irrigation – Systems of Automation and its components – Design – Cost – Operation and maintenance.

UNIT-V: ASSESSMENT OF PARAMETERS IN IRRIGATION **9**

Crop water estimate using Satellite data – Automation of Lysimeter for PET Measurements and Energy based Remote Sensing model – Remote Monitoring design of Automatic Irrigation system - Cost and Benefits of Automation.

TOTAL: 45 PERIODS

OUTCOMES:

- Student will understand the technologies available for automation.

- Students can design conventional methods as automated system to be more Efficient.
- The students will gain knowledge on Automation and control in Surface Irrigation Systems.
- Students can assess the parameters in irrigation.
- Students will learn the Methods of automating Irrigation layout in detail.

TEXT BOOKS:

1. H.R.Haise, E.G.Kruse. et al., 1981. "Automation of Surface Irrigation: 15 years of USDA Research and Development at Fort Collins, Colorado".

REFERENCE BOOKS:

1. Brian Wahlin and Darell Zimbelman, Canal Automation for Irrigation Systems, American Society of Civil Engineers, 2014.
2. Darell D.Zimbelman, Planning, Operation, Rehabilitation and Automation of Irrigation water delivery system, American Society of Agricultural Engineers, 1987.

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1902804 AGRICULTURAL EXTENSION L T P C

3 0 0 3

OBJECTIVES:

- To expose the students to different extension methods for communication to take the work from lab to field

- Understanding the importance of adaptation and mitigation.
- Students are aware of Modern communication sources and capacity building.
- To introduce the students about the innovation in communication.
- To impart the knowledge about the capacity building and training to the farmers.

UNIT-I: COMMUNICATION AND PROGRAMME PLANNING 9

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

UNIT-II: EXTENSION TEACHING METHODS 9

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

UNIT-III: MODERN COMMUNICATION GADGETS 9

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

UNIT-IV: DIFFUSIONAND ADOPTION 9

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

UNIT-V: CAPACITY BUILDING 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- After completion of this course, the students will be familiar with various extension

methods, communication gadgets. Be trained in capacity building techniques.

- Students must know about the advanced and innovative method of passing information.
- Through social media and mobile phones interactive session is held and solution to problems is given
- Importance of adaptation and Innovation decision process and attributes of innovation consequences of adoption.
- Students must know capacity building importance.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

CO	PO												PSO			
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SEMESTER VIII

ELECTIVE –VI

1902805 FARM POWER AND MACHINERY MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To understand the productivity of farm machines, their maintenance processes and evaluation for right selection and management
- To provide sufficient knowledge of mechanization status in the country and management techniques for future requirements.
- To gain knowledge on machinery management.
- To know the concept of System approach.
- To gain knowledge on Quality control.

UNIT- I: INTRODUCTION TO FARM POWER AND DESIGN CRITERIA 9

Modern trends, principles, procedures, fundamentals and economic considerations for design and development of farm power and machinery systems - Reliability criteria in design and its application.

UNIT-II: MACHINERY MANAGEMENT 9

Maintenance and scheduling of operations.Replacement of old machines, repair and maintenance of agricultural machinery, inventory control of spare parts, work study, productivity, method study.First order Markov chains and their applications in sales forecasting and in problems of inventory control and modeling of workshop processes and quality control.

UNIT-III: SYSTEM APPROACH 9

System approach in farm machinery management and application of programming techniques to the problems of farm power and machinery selection.

UNIT-IV: PLANNING OF MACHINERY **9**

Time and motion study, Man-machine task system in farm operations, planning of work system in agriculture, Computer application in selection of power units and to optimize mechanization system.

UNIT-V: ECONOMIC ANALYSIS **9**

Energy conservation - performance and power analysis - cost analysis of machinery - fixed cost and variable costs, effect of inflation on cost; selection of optimum machinery and replacement criteria- Break-even analysis, reliability and cash flow problems; mechanization planning

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to understand the concepts of bio energy sources and its applications.
- The students will be able to do performance, power analysis and cost analysis of machinery.
- The students will gain knowledge on Computer application in selection of power units and to optimize mechanization system.
- The students will be taught to Maintain and schedule operations.
- Students will understand the principles, procedures, fundamentals and economic considerations for development of farm power and machinery systems.

TEXT BOOKS:

1. Bainer, R. Kepner, R.A. and Barger, E.L. “Principles of farm machinery”, John Wiley and Sons, New York, 1978.
2. Liljedahl, B, Tumquist, PK Smith, DW and Hoki, M. “Tractor and its Power Units”, Van Nostrand Reinhold, 1989.
3. Culpin, C, “Farm Machinery”, Granada Publishing Ltd., London, 1978.
4. Kepner, R.A., Bainer, R. and Barger, E.L. “Principles of Farm Machinery”, C.S.B. Publishers and distributors, New Delhi, 1987.

5. Smith, H.P. and Wilkes, L.H. “Farm Machinery and Equipment”, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1979.

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1902806 MECHANICS OF TILLAGE AND TRACTION L T PC

3 0 0 3

OBJECTIVES:

- To impart the fundamental knowledge of mechanics and dynamics in various tillage implements.
- To study the tyres, traction and its applications.
- To understand the concepts of mechanics, dynamics and traction of implements and their applications.
- To gain knowledge on Tillage tools operation.
- To expose the students to the concept of soil compaction.

UNIT-I: MECHANICS OF TILLAGE 9

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

UNIT-II: DYNAMICS OF TILLAGE 9

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

UNIT-III: TRACTION **9**

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

UNIT-IV: TYRES **9**

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

UNIT V APPLICATIONS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

- After completion of the course, the students will be able to understand the concepts of mechanics, dynamics and traction of implements.
- Students will gain knowledge on engineering properties of soil.
- The students will be able to understand and differentiate the applications of mechanics and dynamics.
- The students can design tillage tools.
- The students will be taught about tyres in detail.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Ralph Alcock, “Tractor Implements System”, AVI Publications, 1986.

2. S. C. Jain, “Farm Machinery- An Approach”, Standard Publishers, 2009.

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1902807 SPECIAL FARM EQUIPMENT L T P C

3 0 0 3

OBJECTIVES:

- To study the special machineries used for agricultural applications.
- To learn construction and working of multi crop thresher.
- To gain knowledge on specialized farm equipments.
- To expose students to the concept of Sprayers and dusters.
- To learn about the design of Harvesting equipments.

UNIT-I: MOWERS AND WEEDING EQUIPMENT 9

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

UNIT-II: SPRAYERS AND DUSTERS 9

Sprayers – Sprayer operation – boom sprayer - precaution - coverage - factors affecting

drift. Rotating disc sprayers – Controlled Droplet Application (CDA) - Electrostatic sprayers - Aerial spraying – Air assist sprayers - orchard sprayers - Dusters - types - mist blower cum duster - other plant protection devices, care and maintenance.

UNIT-III: THRESHERS AND HARVESTERS 9

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

UNIT-IV: THRESHERS AND OTHER MACHINERIES 9

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

UNIT-V: SPECIALIZED FARM EQUIPMENT 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- After completion of the course, the students will have a thorough knowledge on special farm equipment required for various agricultural operations.
- The students should be able to understand the use of special farm equipments.
- The students will be taught with the construction and working of various farm equipments.
- The students will understand the importance of using specialized farm equipments.
- The students will be able to differentiate between types of dusters.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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1902808 ERGONOMICS AND SAFETY IN AGRICULTURAL ENGINEERING **L T P C**

3 0 0 3

OBJECTIVES:

- To study the physical work load, equipment/work place design, safety and occupational health hazards in farm operations.
- To introduce the concepts of man machine systems and techniques of providing human comfort in man-making work systems.
- To study the applications of ergonomic principles and physiology of workers.
- To gain knowledge on concept of Ergonomics.

- To Expose students to the concept of Cost benefit analysis.

UNIT-I: ERGONOMICS **9**

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: PHYSIOLOGICAL FUNCTIONS **9**

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

UNIT-III: ENERGY EXPENDITURE **9**

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

UNIT-IV: ANTHROPOMETRY **9**

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

UNIT-V: HUMAN ENGINEERING IN TRACTOR DESIGN **9**

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

OUTCOMES:

- The student will gain knowledge to improve the performance of the farm systems by improving the human - machine interaction with safety measures.
- The student will be able to know the risk factors, guide lines for safe design of man machine systems considering human factors.
- The students will be able to relate the human and workplace factors which contribute to ergonomic hazards
- The students will be able to identify ergonomic hazards and recommend appropriate controls.
- The students will have the knowledge on earth moving machineries, tractor classification and tillage implements.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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OPEN ELECTIVE I

SEMESTER V

1903514 AIR POLLUTION AND CONTROL ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.
- To gain knowledge of characteristics of air pollution and noise pollution.
- To create awareness among the sources and effects of air pollution.
- To gain knowledge on air pollution control equipments.
- To develop a knowledge on air quality standards.

UNIT- I: INTRODUCTION 9

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards – Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

UNIT- II: METEOROLOGY 9

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

UNIT- III: CONTROL OF PARTICULATE CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT- IV: CONTROL OF GASEOUS CONTAMINANTS **9**

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

UNIT- V: INDOOR AIR QUALITY MANAGEMENT **9**

Air quality standards - Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness - Town planning regulations of industries-Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

TOTAL: 45 PERIODS

OUTCOMES:

The students completing the course will have

- An understanding of the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management.
- Ability to identify, formulate and solve air and noise pollution problems.
- Ability to design stacks and particulate air pollution control devices to meet applicable standards.
- Ability to select control equipments.
- Ability to control effects of noise pollution and indoor air pollution.

TEXTBOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science , science media LLC,2004.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press,Inc 2017.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.

REFERENCE BOOKS:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.

2. Arthur C. Stern, "Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.
3. Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.
4. M.N Rao and HVN Rao, "Air Pollution", Tata Mcgraw Hill Publishing Company limited,2007.

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1903515 PARTICIPATORY WATER RESOURCES MANAGEMENT ` L T P C

3 0 0 3

OBJECTIVES:

- To gain an insight on local and global perceptions and approaches on participatory water resource management
- To know the role of farmers in socio economic issues and challenges.
- To bring the knowledge of water conservation.
- To gain knowledge on issues of water management.
- To develop knowledge on global challenges and solutions.

UNIT- I: FUNDAMENTALS: SOCIOLOGY AND PARTICIPATORY APPROACH 9

Sociology – Basic concepts – Perspectives- Social Stratification – Irrigation as a Socio technical Process - Participatory concepts– Needs for participatory -Objectives of participatory approach.

UNIT- II: UNDERSTANDING FARMERS PARTICIPATION 9

Farmers participation - Need and Benefits - Comparisons of cost and benefit -Sustained system performance - Kinds of participation - Context of participation, factors in the environment - WUA - Constraints in organizing FA - Role of Community Organizer – socio economic - Case Studies.

UNIT- III: ISSUES IN WATER MANAGEMENT **9**

Multiple use of water – Issues in Inter-sectoral Water Allocation - domestic, irrigation, industrial sectors - Modernization techniques and its challenges – Command Area Development - Water delivery systems – Advantages and disadvantages.

UNIT-IV:PARTICIPATORY WATER CONSERVATION **9**

Global Challenges -Social – Economic – Environmental - Solutions –Political - Water Marketing –Water Rights -Consumer education – Success Stories Case Studies.

UNIT- V: PARTICIPATORY WATERSHED DEVELOPMENT **9**

Concept and significance of watershed - Basic factors influencing watershed development –Principles of watershed management - Definition of watershed management – Identification of problems - Watershed approach in Government programmes –- People's participation – Entry point activities - Evaluation of watershed management measures.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Gain knowledge on various processes involved in participatory water resource management.
- Understand farmer's participation in water resources management.
- Aware of the issues related to water conservation and watershed Development.
- Get knowledge in participatory water conservation.
- Understand concept, principle and approach of watershed management.

TEXT BOOKS:

1. Sivasubramaniyan, K. “Water Management”, SIMRES Publication, Chennai, 2011.
2. Uphoff.N, “Improving International Irrigation management with Farmer Participation – Getting the process Right – Studies in water Policy and Management”, No.11, West view press, Boulder, CO, 1986.
3. Tideman E.M., “Watershed Management”, Omega Scientific Publishers, New Delhi, 1996.

REFERENCE BOOKS:

1. Chambers Robert, “Managing canal irrigation”, Cambridge University Press, 1989.
2. Murthy, J.V.S., “Watershed Management in India”, Wiley Eastern Ltd., New York, 1995.
3. Sharma V.K. (1989): “Water Resources & Water management”, Himalaya Publishing Bombay.

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1921501 ADVANCED ENGINEERING CHEMISTRY L T P C

3 0 0 3

OBJECTIVES

- To make the students conversant with basics of polymer chemistry.

- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To develop and understand the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.

UNIT-I: POLYMERS AND SPECIALITY POLYMER **9**

Polymers – Types of polymerization – Degree of polymerization – Plastics and types – Mechanism of polymerization (free radical mechanism) properties of polymers - T_g and tacticity – Compounding of plastics – Fabrication of plastics – Blow and extrusion mouldings. Speciality polymers-Conducting polymers: Polyacetylene, polyaniline, synthesis, mechanism of conduction – Applications of conducting polymers. Bio-degradable polymers: Requirements, factors affecting degradation – PLA– preparation, properties –applications.

UNIT-II: ENERGY SOURCES AND STORAGE DEVICES **9**

Solar energy conversion – Solar cells: Types – Wind energy. Batteries: Types of batteries – Primary battery (alkaline battery), secondary battery (lead acid battery, NICAD battery, lithium, lithium-ion & lithium-sulphur battery), fuel cells – H_2-O_2 fuel cell.

UNIT-III: PHOTOCHEMISTRY & ANALYTICAL TECHNIQUES **9**

Photochemistry: Laws of photochemistry - Grothuss–Draper law, Stark–Einstein law and Beer-Lambert's Law. Quantum efficiency – determination - Photophysical processes (Jablonski diagram) - photosensitization - Chemiluminescence and bioluminescence. Analytical techniques: IR, UV – principle, Instrumentation and

applications. Thermal analysis: TGA & DTA - principle, instrumentation and applications. Chromatography: Basic principles of column & TLC – principles and applications.

UNIT-IV: THERMODYNAMICS **9**

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; Entropy of phase transitions; Clausius inequality. Free energy and work function- Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius- Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore.

UNIT-V: PHASE RULE AND ALLOYS **9**

Phase rule: Introduction, definition of terms with examples, One component system - Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process, Zn-Mg System. Alloys: Introduction- Definition- properties of alloys- Significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel.

TOTAL: 45 PERIODS

OUTCOMES

At the end of the course, the student should be able to

- Gain knowledge on polymer chemistry and its developments.
- Understand the process of advanced energy storage devices.
- Analyze the materials using spectroscopic techniques.
- Explain the various state of thermodynamics.
- Outline the nature of alloys by drawing phase rule.

TEXT BOOKS:

1. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2016.

2. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India PVT, LTD, New Delhi, 2015.
3. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd., 2012.

REFERENCE BOOKS:

1. P. C. Jain and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2019.
2. S. S. Dara and S. S. Umare, “A Textbook of Engineering Chemistry”, S. Chand & Company LTD, New Delhi, 2015.
3. B. K. Sharma, “Engineering Chemistry”, Krishna Prakashan Media (P) Ltd, Meerut, 2012.

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1921502 INDUSTRIAL NANOTECHNOLOGY L T P C

3 0 0 3

OBJECTIVES

- To elucidate on advantages of nanotechnology based applications in each industry.
- To provide instances of contemporary industrial applications of nanotechnology.

- To provide an overview of future technological advancements and increasing role of nanotechnology in each industry.
- To provide an awareness on the nanomaterial synthesis for electronic materials.
- To make the student conversant with the latest characterization techniques.

UNIT-I: NANO ELECTRONICS **9**

Micro and Nanoelectromechanical systems – Sensors, Actuators, Data memory – Lighting and Displays – Applications of piezoelectric and ferroelectric materials- Nano for energy systems - Fuel cells and Photo-voltaic cells – Electric double layer capacitors –Nanoparticle coatings for electrical products.

UNIT-II: BIO NANOTECHNOLOGY **9**

Nanoparticles in bone substitutes and dentistry – Implants and Prosthesis – Nanorobotics in Surgery –Nanosensors in Diagnosis– Neuro-electronic Interfaces– Therapeutic applications.

UNIT-III: NANOTECHNOLOGY IN CHEMICAL INDUSTRY **9**

Nanocatalyts – Smart materials – Heterogenous nanostructures and composites – Nanostructures for Molecular recognition (Quantum dots, Nanorods, Nanotubes) – Molecular Encapsulation and its applications – Nanoporous zeolites – Self-assembled Nanoreactors.

UNIT-IV: NANOTECHNOLOGY IN AGRICULTURE AND FOOD TECHNOLOGY **9**

Nanotechnology in Agriculture -Precision farming, Smart delivery system – Insecticides using nanotechnology – Potential of nano-fertilizers - Nanotechnology in Food industry.

UNIT-V: CHARACTERIZATION TECHNIQUES **9**

X-ray Diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including High-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

TOTAL: 45 PERIODS

OUTCOMES

At the end of the course, the student should be able to

- Analyze the nanoparticle coatings for electrical products.
- Define various therapeutic applications of bionanotechnology.
- Explain the process of molecular encapsulation and nanoreactors.
- Ability to understand the uses of nanotechnology in food industry.
- Outline the nanofiber production and formulation of gels.

TEXTBOOKS:

1. V.A. Rai and J.A. Bai, Nanotechnology Applications in the Food Industry, CRC Press, 2018.
2. S. Thomas, Y. Grohens and Y.B. Pottathara, Industrial Applications of Nanomaterials, Elsevier Press, 2019.
3. N John Dinardo, Nanoscale Characterization of surfaces & Interfaces, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCE BOOKS:

1. Neelina H. Malsch, Biomedical Nanotechnology, CRC Press, 2005.
2. Udo H. Brinker, Jean-Luc Mieusset, Molecular Encapsulation: Organic Reactions in Constrained Systems, Wiley Publishers, 2010.
3. Jennifer Kuzma and Peter VerHage, Nanotechnology in Agriculture and Food Production, Woodrow Wilson International Center, 2006.
4. P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, Cambridge, 2007.
5. Y-W. Mai, Polymer Nano composites, Woodhead Publishing Limited, 2006.
6. W.N. Chang, Nanofibres fabrication, performance and applications, Nova Science Publishers Inc, 2009.

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1904007 DATA STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To understand Linear Data structures programs.
- To understand Nonlinear Data structures program
- To have an idea about implementing search techniques.
- To have a better understanding in sorting techniques.
- To understand the various Indexing algorithms.

UNIT-I: LINEAR DATA STRUCTURES - LIST 9

Introduction to structure-Abstract Data Types (ADTs) - List ADT - array-based implementation - linked list implementation - singly linked lists- circularly linked lists - applications of lists –Polynomial Manipulation.

UNIT-II: LINEAR DATA STRUCTURES - STACKS, QUEUES 9

Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue –applications of queues.

UNIT-III: NON LINEAR DATA STRUCTURES TREES- GRAPHS 9

Binary Trees – Binary tree representation and traversals – Application of trees: – Graph and its representations – Graph Traversals – Connected components.

UNIT-IV: SORTING **9**

Selection sort-Insertion sort – Merge sort – Quick sort – Heap sort – Bubble sort- Shell sort – Radix sort.

UNIT-V: SEARCHING AND INDEXING **9**

Linear Search – Binary Search - Hash tables – Overflow handling – Hash Index – B-Tree Indexing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures, Galgotia Book Source, Gurgaon, 1976.
2. Gregory L. Heilman, Data Structures, Algorithms and Object Oriented Programming, Tata Mcgraw-Hill, New Delhi, 2002.

REFERENCES:

1. Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, New Delhi, 1991.
2. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures and Algorithms, Pearson Education, New Delhi, 2006.

OUTCOMES:

- To learn about Linear Data structures
- Ability to describe stack queue and linked list operation
- Ability to analyze algorithms
- To understand about the tree concepts.
- Ability to summarize searching and sorting techniques.

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1904504 GEOGRAPHIC INFORMATION SYSTEM L T P C

3 0 0 3

OBJECTIVES

- To introduce the fundamentals and components of Geographic Information System.
- To provide details of spatial data structures and input, management and output processes.
- To provide details about raster input data structures.
- To be familiar with network topologies.
- To Analyze data analytics and various applications of GIS.

UNIT - I: FUNDAMENTALS OF GIS 9

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - geographical data types - Spatial, Attribute data- types of attributes – scales/ levels of measurements.

UNIT – II: SPATIAL DATA MODELS 9

Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models TIN and GRID data models - OGC standards - Data Quality.

UNIT - III: DATA INPUT AND TOPOLOGY **9**

Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.

UNIT - IV: DATA ANALYSIS **9**

Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.

UNIT - V: APPLICATIONS **9**

GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies

TOTAL: 45 PERIODS

OUTCOMES:

This course equips the student to

- Have basic idea about the fundamentals of GIS.
- Understand the types of data models.
- Get knowledge about data input and topology.
- Gain knowledge on data quality and standards.
- Understand data management functions and data output.

TEXT BOOKS:

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.

2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition, 2007.

REFERENCE BOOKS:

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006.

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1904508 DATABASE MANAGEMENT SYSTEM L T P C

3 0 0 3

OBJECTIVES:

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study SQL and relational database design.

- To understand the fundamental concepts of transaction processing- concurrency control techniques recovery procedures
- To have an introductory knowledge about Query Processing.
- To analyze the different DB storage like XML,ODMG etc. in distributed environment

UNIT –I: INTRODUCTION TO DATABASE **9**

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping.

UNIT –II: RELATIONAL DATABASE **9**

Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.

UNIT –III: DATABASE DESIGN **9**

Functional Dependencies – Non-loss Decomposition -First, Second, Third Normal Forms, Dependency Preservation – Boyce Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT –IV: TRANSACTION PROCESSING AND CONCURRENCY CONTROL **9**

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT –V: IMPLEMENTATION TECHNIQUES **9**

RAID – File Organization – Organization of Records in Files – Indexing and Hashing – Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Query optimization using Heuristics and Cost Estimation.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to:

- Classify the modern and futuristic database applications based on size and complexity
- Map ER model to Relational model to perform database design effectively
- Write queries using normalization criteria and optimize queries.
- Compare and contrast various indexing strategies in different database systems
- Appraise how advanced databases differ from traditional databases.

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Database System Concepts, Sixth Edition, Tata McGraw Hill, 2011
2. Ramez Elmasri, Shamkant B. Navathe, —Fundamentals of Database Systems, Sixth Edition, Pearson, 2011.

REFERENCE BOOKS:

1. C. J. Date, A.Kannan, S. Swamynathan, —An Introduction to Database Systems‖, Eighth Edition, Pearson Education, 2006.
2. Raghu Ramakrishnan, —Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.
3. G.K.Gupta, "Database Management Systems‖, Tata McGraw Hill, 2011.

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1904509 CLOUD COMPUTING L T P C

3 0 0 3

OBJECTIVES:

- To understand the concept of cloud computing.
- To appreciate the evolution of cloud from the existing technologies.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

UNIT- I: INTRODUCTION 9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics.

UNIT- II: CLOUD ENABLING TECHNOLOGIES 9

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices.

UNIT –III: CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

UNIT –IV: RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards.

UNIT –V: CLOUD TECHNOLOGIES AND ADVANCEMENTS 9

Hadoop – Map Reduce –Google App Engine – Programming Environment for Google App Engine –– Amazon Web services-Open Stack – Federation in the Cloud.

TOTAL: 45 PERIODS

OUTCOMES:

On Completion of the course, the students should be able to:

- Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- Learn the key and enabling technologies that help in the development of cloud.
- Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
- Explain the core issues of cloud computing such as resource management and security.
- Be able to install and use current cloud technologies.

TEXT BOOKS:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

2. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.

REFERENCE BOOKS:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

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1906505 PHOTONIC NETWORKS L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To enable the students to manifest the components used is the optical system, propagation of signals and their impairments in optical fiber.
- To enable the student to understand the importance of the backbone infrastructure for our present and future communication needs.
- To familiarize the students about the optical network architectures and the protocol stack in use.
- To enable the student to understand the differences in the design of data plane and the control plane and the routing, switching and the resource allocation methods and the network management and protection methods in vogue.
- To expose the student to the advances in networking and switching domains and the future trends.

UNIT - I: OPTICAL SYSTEM COMPONENTS **9**

Light Propagation in optical fibers – Loss & bandwidth, System limitations, Nonlinear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT - II: OPTICAL NETWORK ARCHITECTURES **9**

Introduction to Optical Networks; Wavelength Division Multiplexing, optical add/drop multiplexer, SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Wavelength Routing Architecture.

UNIT - III: WAVELENGTH ROUTING NETWORKS **9**

The optical layer, Optical Network Nodes, Routing and wavelength assignment, Traff ic Grooming in Optical Networks, Architectural variations- Linear Light wave networks, Logically Routed Networks.

UNIT - IV: PACKET SWITCHING AND ACCESS NETWORKS **9**

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM networks, Switch-based networks, Contention Resolution Access Networks – Network Architecture overview, Optical Access Network Architectures and OTDM networks, OTDR.

UNIT - V: NETWORK DESIGN AND MANAGEMENT **9**

Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion, Wavelength stabilization, Overall design considerations, Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL: 45 PERIODS

OUTCOMES:

The student should be able to:

- Elucidate the components in an optical system.
- Use the backbone infrastructure for our present and future communication needs.
- Analyze the architectures and the protocol stack.
- Compare the differences in the design of data plane, control plane, routing, switching, resource allocation methods.
- Annotate the network management and protection methods in vogue.

TEXT BOOKS:

1. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks: A Practical Perspective”, Second Edition, Harcourt Asia Pte Ltd., 2004.
2. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, 1st Edition, Prentice Hall of India, 2002.

REFERENCE BOOKS:

1. John M. Senior ,“Optical Fiber Communication”,3rd edition, Prentice Hall,2009.
2. Uyless N. Black, “Optical Networks, Third Generation Transport Systems”,1st Edition, Prentice hall of India, 2002.
3. Biswanath Mukherjee, “Optical WDM Networks”, Springer Series, 2006.
4. Govind P. Agrawal, “Fiber Optic Communication Systems”, 3rd Edition, Wiley India (P) Ltd, 2002.
5. Gerd Keiser , “Optical Fiber Communication” , 5th Edition , McGraw Hill Education (India) Pvt. Ltd. , 2013.

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1906506 TELECOMMUNICATION NETWORK MANAGEMENT **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the concept of network management standards.
- To design the common management information service element model.
- To analyze the various concept of information modeling.
- To examine the concept of SNMPv1 and SNMPv2 protocol.
- To exhibit the examples of network management.

UNIT –I: BASIC FOUNDATIONS AND NETWORK MANAGEMENT APPLICATIONS 9

Network management standards–Network management model– Organization model–

Information model - Abstract syntax notation One (ASN.1) – Encoding structure– Macros –Functional model. Network management applications functional requirements: Configuration management– Fault management–Performance management–Error correlation technology– Security management–Accounting management– Common management–report management– Policy based management – Service level management – Management service– Community definitions– capturing the requirements– simple and formal approaches–semi formal and formal notations.

UNIT - II: COMMON MANAGEMENT INFORMATION SERVICE ELEMENT 9

CMISE model–service definitions–errors–scooping and filtering features–synchronization–functional units– association services– common management information protocol specification.

UNIT - III: INFORMATION MODELING FOR TMN 9

Rationale for information modeling–management information model–object oriented modeling paradigm– structure of management information–managed object class definition–management information base.

UNIT - IV: SIMPLE NETWORK MANAGEMENT PROTOCOL 9

SNMPv1: Managed networks–SNMP models– organization model– Information model–SNMPv1 communication model–functional model. SNMPv2-major changes in SNMPv2–structure of management information, MIB–SNMPv2 protocol– compatibility with SNMPv1. SNMPv3– architecture–applications–MIB- security, SNMP Management: remote monitoring–SMI and MIB– RMON1 and RMON2.

UNIT - V: NETWORK MANAGEMENT EXAMPLES 9

ATM integrated local management interface–ATM MIB–M1– M2–M3–M4–interfaces–ATM digital exchange interface management–digita1 subscriber loop and asymmetric DSL technologies–ADSL configuration management–performance management

Network management tools: Network statistics management–network management system–management platform case studies: OPENVIEW–ALMAP.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student should be able to,

- Design and analyze of fault management.
- Analyze the common management information protocol specifications.
- Explain the functioning and design of management information model.
- Describe the simple network management protocol.
- Interpret the various types of network management tools with case studies.

TEXT BOOKS:

1. Mani Subramanian, “Network Management: Principles and Practice”, Pearson Education, Second edition, 2010.
2. Lakshmi G Raman, “Fundamentals of Telecommunications Network Management”, Wiley, 1999.

REFERENCE BOOKS:

1. Henry Haojin Wang, “Telecommunication Network Management”, Mc- Graw Hill, 1999.
2. Salah Aidarous & Thomas Plevyak, “Telecommunication Network Management: Technologies and Implementations”, Wiley, 1997.
3. Singh B, “Network Security and Management”, Eastern Economy Edition, 2012.

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1906507 **ENTERTAINTRONICS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the basics of display devices.
- To enhance the student knowledge in Audio broadcasting systems.
- To enable the student to learn about Television systems.
- To develop the student knowledge in Interactive Gaming Applications.
- To apply the knowledge of Consumer Electronic Applications.

UNIT - I: DISPLAY DEVICES **9**

Introduction – Underlying technologies of displays -Types of Electronic displays – Segment displays –Two dimensional displays: Liquid Crystal display, Light emitting diode display – Three dimensional displays: Laser display, Holographic display – Applications.

UNIT - II: AUDIO BROADCASTING SYSTEMS **9**

Loud Speakers: construction, working principles and applications of crystal, condenser and dynamic loudspeakers – Tweeters, Squawkers & Woofers - Public address system - Requirements of Public Addressing system -Microphones: construction, working principles and applications of Carbon, Moving coil and Crystal microphones. Headphones: Principle of operation of crystal and dynamic and Bluetooth based headphones.

UNIT - III: TELEVISION SYSTEMS **9**

Basics of Television: Television standards, frequency bands, Scanning method, interlacing and synchronization, bandwidth, Advanced TV systems: LCD, LED, HDTV,3DTV, Smart TV. Color concepts, concepts of luminance, Hue and Saturation, Color TV (PAL Systems). Cable TV concepts, Closed Circuit Television.

UNIT - IV: INTERACTIVE GAMING APPLICATIONS **9**

Fundamental of game design - Gaming scenarios – Interfaces- Multi player interactive gaming – Programming concepts – educational games – Privacy and security in games – Introduction to Android games and its development – Online games.

UNIT - V: CONSUMER ELECTRONIC APPLICATIONS **9**

Principle of operation of digital clocks, electronic calculator, cellular phones- smart phonesmicrowave ovens, washing machines, air conditioners, ATMs and set-top-boxes – Compact Ultrafast Fiber lasers for Consumer electronics – Virtual reality applications, Alexa.

TOTAL: 45 PERIODS

OUTCOMES:

The student should be able to:

- Understand the basic applications of display devices.
- Analyze the operation of Audio devices and its applications.
- Know the basic TV Standards and the basics of Television.
- Design the Gaming scenarios and knowing programming concepts.
- Apply the knowledge on the applications of Consumer electronics.

TEXT BOOKS:

1. Shoichi Matsumoto, “Electronic display devices”, Wiley, 1990.
2. Ajay Sharma, “Audio video and TV Engineering-Consumer Electronics”, Dhanpat Rai and co, 2003.
3. R.G. Gupta, “Audio and Video systems”, Tata Mc Graw Hill Publishing Co.Ltd, 2010.

REFERENCE BOOKS:

1. R. Gulati, “Monochrome and Color Television”, New Age International (P) Ltd, New Delhi, 2014.
2. S P Bali, “Consumer Electronics”, Pearson, 2007.

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1905001 ENERGY CONSERVATION AND MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

At the end of the course, the student is expected to

- Understand and analyse the energy data of industries.
- Carryout energy accounting and balancing.
- Conduct energy audit and suggest methodologies for energy savings.
- Utilize the available resources in optimal ways
- Understand and analyse of Energy Economics.

UNIT-I: INTRODUCTION 9

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT-II: ELECTRICAL SYSTEMS 9

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency

Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT-III: THERMAL SYSTEMS **9**

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories.

UNIT-IV: ENERGY CONSERVATION IN MAJOR UTILITIES **9**

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets.

UNIT-V: ECONOMICS **9**

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Can able to analyse the energy data.
- Can carryout energy accounting and balancing.
- Can suggest methodologies for energy savings.
- Can carry out Energy Conservation in Major Utilities.
- Can suggest methodologies for Energy Economics.

TEXTBOOKS:

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004

REFERENCES:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and

Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford,1981.
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982.
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987.

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1905508 RENEWABLE ENERGY SOURCES L T P C

3 0 0 3

OBJECTIVES:

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

UNIT-I: PRINCIPLES OF SOLAR RADIATION 10

Role and potential of new and renewable source, the solar energy option, Environmental

impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT-II: SOLAR ENERGY COLLECTION 8

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT-III: SOLAR ENERGY STORAGE AND APPLICATIONS 8

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT-IV: WIND ENERGY 10

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

UNIT-V: GEOTHERMAL ENERGY 9

Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics. DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC-Magneto Hydro Dynamic power generation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Understanding the physics of solar radiation.
- Ability to classify the solar energy collectors and methodologies of storing solar

energy.

- Knowledge in applying solar energy in a useful way.
- Knowledge in wind energy and biomass with its economic aspects.
- Knowledge in capturing and applying other forms of energy sources like wind, biogas and geothermal energies.

TEXTBOOKS:

1 Rai G.D., “Non-Conventional Energy Sources”, Khanna Publishers, 2011.

2. Twidell & Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011.

REFERENCE BOOKS:

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007.
2. Ramesh R & Kumar K.U, “Renewable Energy Technologies”, Narosa Publishing House, 2004.
3. Mittal K M, “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi, 2003.

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1905509 SCADA SYSTEM MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To provide knowledge about the SCADA system and its architecture
- To provide knowledge about SCADA system components
- To provide knowledge about SCADA communication protocols
- To provide knowledge about SCADA monitoring and control in power system
- To provide knowledge about SCADA applications in power system

UNIT I INTRODUCTION 9

Evolution of SCADA, SCADA definitions, SCADA Functional requirements and Components, SCADA Hierarchical concept, SCADA architecture, General features, SCADA Applications, Benefits

UNIT II SCADA SYSTEM COMPONENTS 9

Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels

UNIT III COMMUNICATION 9

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fiber optic, PLCC etc. Interface provisions and communication extensions, synchronization with NCC, DCC.

UNIT IV MONITORING AND CONTROL 9

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control

and disconnector control.

UNIT V APPLICATIONS IN POWER SYSTEM 9

Applications in Generation, Transmission and Distribution sector, Substation SCADA system Functional description, System specification, System selection such as Substation configuration, IEC61850 ring configuration, SAS cubicle concepts, gateway interoperability list, signal naming concept. System Installation, Testing and Commissioning.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- This course gives knowledge about SCADA SYSTEM and its architecture
- This course gives knowledge about various system components of SCADA system
- This course gives knowledge about various communication protocols of SCADA system
- This course gives knowledge about SCADA monitoring and control in power system
- This course gives knowledge about SCADA system applications

TEXTBOOKS:

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications,USA,2004
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004
3 William T. Shaw, Cybersecurity for SCADA systems, PennWell Books, 2006

REFERENCE BOOKS:

1. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003
2. Michael Wiebe, A guide to utility automation: AMR, SCADA, and IT systems for

electric Power, PennWell 1999

3. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, “Engineering of Distributed Control Systems”, Nova Science Publishers, USA, 1st Edition, 2001

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1907503 SENSORS AND TRANSDUCERS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the applications and working of motion and ranging sensors.
- To explore the latest sensor technologies like MEMS & nano sensors, smart sensors
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT – I: INTRODUCTION 9

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT – II: MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT – III: FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT – IV: OPTICAL, PRESSURE AND TEMPERATURE SENSORS **9**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT – V: SIGNAL CONDITIONING and DAQ SYSTEMS **9**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the students will be able to:

- Explain various calibration techniques and signal types for sensors.
- Understand the basic principles of various sensors.
- Illustrate the basic principles of various smart sensors.

- Apply the various sensors in the Automotive and Mechatronics applications
- Implement the DAQ systems with different sensors for real time applications

TEXT BOOKS:

1. Ernest O Doebelin, Dhanesh N.Manik “Measurement Systems – Applications and Design”, seventh Edition, McGraw-Hill, 2019.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCE BOOKS:

1. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
3. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.

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1907504 INSTRUMENTATION IN BIOMEDICAL ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To study about the different bio potential and its propagation
- To understand the different types of electrodes and its placement for various recording
- To study the design of bio amplifier for various physiological recording
- To learn the different measurement techniques for non-physiological parameters.
- To familiarize the different biochemical measurements.

UNIT – I: BIO POTENTIAL GENERATION AND ELECTRODES TYPES 9

Origin of bio potential and its propagation. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes

UNIT – II: BIOSIGNAL CHARACTERISTICS AND ELECTRODECONFIGURATIONS 9

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

UNIT – III: SIGNAL CONDITIONING CIRCUITS 9

Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering

UNIT – IV: MEASUREMENT OF NON-ELECTRICALPARAMETERS 9

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.

UNIT – V: BIO-CHEMICAL MEASUREMENT **9**

Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Understand the different bio potential and its propagation.
- Explain the different electrode placement for various physiological recording
- Design bio amplifier for various physiological recording
- Understand various technique of non electrical physiological measurements
- Understand the different biochemical measurements

TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.
2. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2004. (Units I, II & V)

REFERENCE BOOKS:

1. Myer Kutz, “Standard Handbook of Biomedical Engineering and Design”, McGraw Hill Publisher, 2003.
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.(Units II & IV)

3. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2004.

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1908001 3D PRINTING AND DESIGN L T P C

3 0 0 3

OBJECTIVES:

- The course is designed to impart knowledge and skills related to 3D printing technologies.
- Selection of material and equipment and develop a product using this technique.
- To understand Industry 4.0 environment.
- To understand CAD and Additive manufacturing
- To understand Additive Equipment.

UNIT - I: 3D PRINTING AND ADDITIVE MANUFACTURING 9

Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturingprocesses, Applications.

UNIT - II: CAD AND ADDITIVE MANUFACTURING 9

CAD for Additive Manufacturing-CAD Data formats, Data translation, Data loss, STL format. Additive Manufacturing Techniques - Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology.

UNIT - III: PROCESS **9**

Process, Process parameter, Process Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools

UNIT - IV: MATERIALS **9**

Polymers, Metals, Non-Metals, Ceramics, Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials.

UNIT - V: ADDITIVE MANUFACTURING EQUIPMENT **9**

Process Equipment- Design and process parameters-Governing Bonding Mechanism-Common faults and troubleshooting - Process Design- Post Processing: Requirement and Techniques- Product Quality.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Develop CAD models for 3D printing.
- Import and Export CAD data and generate .stl file.
- Select a specific material for the given application.
- Select a 3D printing process for an application.
- Produce a product using 3D Printing or Additive Manufacturing (AM).

TEXT BOOKS:

1. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies:

Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
2. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.

REFERENCE BOOKS:

1. Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi. CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.
2. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013.
3. L. Lu, J. Fuh and Y.S. Wong, "Laser-Induced Materials and Processes for Rapid Prototyping", Kulwer Academic Press, 2001.
4. Zhiqiang Fan And Frank Liou, "Numerical Modelling of the Additive Manufacturing (AM) Processes of Titanium Alloy", InTech, 2012.

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CO 4		2	3												2	
CO 5					2				3						2	

1908002 SCRIPTING LANGUAGES L T P C

3 0 0 3

OBJECTIVES:

- The principles of scripting languages.

- Difference between scripting languages and non- scripting languages.
- Types of scripting languages.
- Scripting languages such as PERL, TCL/TK, python and BASH.
- Creation of programs in the Linux environment and usage of scripting languages in IC design flow.

UNIT - I: LINUX BASICS **9**

Introduction to Linux , File System of the Linux, General usage of Linux kernel & basic commands, Linux users and group, Permissions for file, directory and users, searching a file & directory, zipping and unzipping concepts.

UNIT - II: LINUX NETWORKING **9**

Introduction to Networking in Linux, Network basics & Tools, File Transfer Protocol in Linux, Network file system, Domain Naming Services, Dynamic hosting configuration Protocol & Network information Services.

UNIT - III: PERL SCRIPTING **9**

Introduction to Perl Scripting, working with simple values, Lists and Hashes, Loops and Decisions, Regular Expressions, Files and Data in Perl Scripting, reference & Subroutines, Running and Debugging Perl, Modules, Object – Oriented Perl.

UNIT - IV: TCL / TK SCRIPTING **9**

Tcl Fundamentals, String and Pattern Matching, Tcl Data Structures, Control Flow Commands, Procedures and Scope, Evel, Working with Unix, Reflection and Debugging, Script Libraries, Tk Fundamentals, Tk by examples, The Pack Geometry Manager, Binding Commands to X Events, Buttons and Menus, Simple Tk Widgets, Entry and List box Widgets Focus, Grabs and Dialogs.

UNIT - V: PYTHON SCRIPTING **9**

Introduction to Python, using the Python Interpreter, More Control Flow Tools, Data Structures, Modules, Input and Output, Errors and Exceptions, Classes, Brief Tour

of the Standard Library.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Create and run scripts using PERL in IC design flow.
- Create and run scripts using TCl in IC design flow
- Create and run scripts using Python in IC design flow
- Use Linux environment and write programs for automation of scripts in VLSI tool design flow.
- Usage of scripting languages in IC design flow.

TEXT BOOKS:

1. Python Tutorial by Guido Van Rossum, Fred L. Drake Jr. editor , Release 2.6.4
2. Practical Programming in Tcl and Tk by Brent Welch, Updated for Tcl 7.4 and Tk4.0.
3. Teach Yorself Perl in 21 days by David Till.
4. Red Hat Enterprise Linux 4 : System Administration Guide Copyright, 2005 Red Hat Inc.

REFERENCE BOOKS:

1. Learning Python – 2nd Ed., Mark Lutz and David Ascher, 2003, O'Reilly.
2. Perl in 24 Hours – 3rd Ed., Clinton Pierce, 2005, Sams Publishing.
3. Learning Perl – 4th Ed. Randal Schwartz, Tom Phoenix and Brain d foy. 2005.
4. Jython Essentials – Samuele Pedroni and Noel Pappin.2002. O'Reilly.
5. Programming Perl – Larry Wall, Tom Christiansen and John Orwant, 3rd Edition, O'Reilly, 2000. (ISBN 0596000278)

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1910504 PRINCIPLES OF FOOD PRESERVATION L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To learn about the shelf life of food products.
- To gain knowledge on the storage of food products.
- To know about the thermal processing methods of food.
- To design different types of Dryers.
- To understand the non-thermal methods of food preservation.

UNIT - I: FOOD PRESERVATION AND ITS IMPORTANCE 9

Introduction to food preservation, Wastage of processed foods; Shelf life of food products; Types of food based on its perishability, Traditional methods of preservation.

UNIT - II: METHODS OF FOOD HANDLING AND STORAGE 9

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots

and tubers; freezing of raw and processed foods. Retort pouch packing, Aseptic packaging.

UNIT - III: THERMAL METHODS **9**

Newer methods of thermal processing; batch and continuous; In container sterilization-canning; application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods.

UNIT - IV: DRYING PROCESS FOR TYPICAL FOODS **9**

Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychometric chart, freezing and cold storage, freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT - V: NON-THERMAL METHODS **9**

Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology.

TOTAL: 45 PERIODS

OUTCOMES:

The student should be able to:

- Aware of the different methods applied to preserving foods.
- Explain the food handling and storage processes.
- Analyze the thermal processing and osmotic methods.
- Explore the drying process of foods.
- Apply the non-thermal methods for food preservation.

TEXT BOOKS:

1. Karnal, Marcus and D.B. Lund, “Physical Principles of Food Preservation”, Second Edition, Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M, “Food Preservation and Safety Principles and Practice”, Surbhi Publications, 2001.

3. Sivasankar B, “Food Processing & Preservation”, Prentice Hall of India, 2002.
4. Neelam Khetarpaul, “Food Processing and Preservation”, Daya Publishing House, A division of Astral International (P) Ltd., 2015.

REFERENCE BOOKS:

1. Shafiur M Rahman, “Handbook of Food Preservation”, Second Edition, CRC Press, 2007.
2. Zeuthen Peter, Bogh-Sorensen Leif, “Food Preservation Techniques”, Wood Head Publishing, Cambridge, England, 2005.
3. Ranganna S, “Handbook of Canning and Aseptic Packaging”, Tata McGraw-Hill, 2000.

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1909510 PRODUCT DESIGN AND DEVELOPMENT L T P C

3 0 0 3

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Product design and development
- Apply the concept of prototyping in a real-life problem.
- Reduce the waste by using product architecture.
- Understand the concepts of industrial design.
- Understand the concepts of DFM

UNIT-I: INTRODUCTION **9**

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements.

UNIT-II: CONCEPT GENERATION AND SELECTION **9**

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT-III: PRODUCT ARCHITECTURE **9**

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions.

UNIT-IV: INDUSTRIAL DESIGN **9**

Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT-V: DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT **9**

Definition – Estimation of manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Product design and development.
- Apply the concept of prototyping in a real life problem.
- Reduce the waste by using product architecture**.**
- Understand the concepts of industrial design.
- Understand the concepts of DFM

TEXTBOOKS:

1. Kari T.Ulrich and Steven D.Eppinger, ”Product Design and Development”, McGraw-Hill International Edn.2017.

REFERENCE BOOKS:

1. Kemnneth Crow, “Concurrent Engg./Integrated Product Development”, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, “Effective Product Design and Development”, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.

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1909511 VIBRATION AND NOISE CONTROL L T P C

3 0 0 3

OBJECTIVES:

- The main learning objective of this course is to prepare the students for:
- Apply the fundamental concepts of vibration.
- Apply the fundamentals of noise.
- Describe the various sources of noise for automotive applications.
- Determine the natural frequencies and mode shapes of the two degree freedom systems.
- Describe the different types of noise and its control measures

UNIT-I: BASICS OF VIBRATION 9

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT-II: BASICS OF NOISE 9

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT-III: AUTOMOTIVE NOISE SOURCES 9

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.

UNIT-IV: CONTROL TECHNIQUES **9**

Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT-V: SOURCE OF NOISE AND CONTROL **9**

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Apply the fundamental concepts of vibration.
- Apply the fundamentals of noise.
- Describe the various sources of noise for automotive applications.
- Determine the natural frequencies and mode shapes of the two degree freedom systems.
- Describe the different types of noise and its control measures.

TEXTBOOKS:

1. Singiresu S.Rao, “Mechanical Vibrations”, 6th Edition, Pearson Education, 2016

REFERENCE BOOKS:

1. Balakumar Balachandran and Edward B. Magrab, “Fundamentals of Vibrations”, 1st Editon, Cengage Learning, 2009
2. Benson H. Tongue, “Principles of Vibrations”, 2nd Edition, Oxford University, 2007

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1909512 INDUSTRIAL SAFETY ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Identify unsafe conditions and recognize unsafe alerts.
- Interpret the rules and regulations for safety operations.
- Capable of solving problem of accidents.
- Capable of solving the present for criticizing the present for improved safety.
- Collaborate and modify processes / procedures for safety.

UNIT-I: INTRODUCTION 9

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT-II: CHEMICAL HAZARDS 9

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

UNIT-III: ENVIRONMENTAL CONTROL 9

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT-IV: HAZARD ANALYSIS **9**

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

UNIT-V: SAFETY REGULATIONS **9**

Explosions – Disaster management – catastrophe control, hazard control , Factories Act, Safety regulations Product safety – case studies.

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Identify and prevent chemical, environmental mechanical, fire hazard.
- Collect, analyze and interpret the accidents data based on various safety techniques.
- Apply proper safety techniques on safety engineering and management.
- Able to perform hazard analysis.
- Aid to design the system with environmental consciousness by implementing safety regulation.

TEXTBOOKS:

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.

REFERENCE BOOKS:

1. David L.Goetsch, “Occupational Safety and Health for Technologists”, Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.
2. Deshmukh L M, “Industrial Safety Management”, Tata McGraw-Hill Publishing Company Ltd.,2005

3. Safety Manual, “EDEL Engineering Consultancy”, 2000

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1920501 NANOTECHNOLOGY L T P C

3 0 0 3

OBJECTIVES

- Make the students to understand the fundamentals of nanomaterials.
- To acquire the knowledge on different classifications in nano materials.
- To educate the different synthesis techniques.
- To provide information on different fabrication and characterization techniques.
- Make the students to understand and apply the techniques to different systems.

UNIT -I: BASICS OF NANOTECHNOLOGY 9

Introduction –Scientific revolutions –Time and length scale in structures –Definition of a nanosystem –Dimensionality and size dependent phenomena –Surface to volume ratio -Fraction of surface atoms-Properties at nanoscale (optical, mechanical, electronic and magnetic).

UNIT- II:DIFFERENT CLASSES OF NANOMATERIALS 9

Classification based on dimensionality-Quantum Dots, Wells and Wires-Carbon-based

nano materials (buckyballs, nanotubes, graphene)–Metal based nano materials (nanogold, nanosilver and metal oxides) –Nanocomposites-Nanopolymers –Nanoglasses –Nano ceramics.

UNIT-III: SYNTHESIS OF NANOMATERIALS 9

Classification of synthesis: Top down and bottom up nanofabrication. Chemical Methods: Solvothermal Synthesis-Photochemical Synthesis –Sonochemical Routes- Chemical Vapor Deposition (CVD) –Metal Oxide -Chemical Vapor Deposition (MOCVD). Physical Methods: Ball Milling –Electrodeposition -Spray Pyrolysis -Flame Pyrolysis - DC/RF Magnetron Sputtering -Molecular Beam Epitaxy (MBE).

UNIT-IV: FABRICATION AND CHARACTERIZATION OF NANOSTRUCTURES 9

Nanofabrication: Photolithography and its limitation-Electron-beam lithography (EBL)-Nanoimprint –Softlithography patterning. Characterization: Environmental Scanning Electron Microscopy (ESEM) High Resolution Transmission Electron Microscope (HRTEM) –Scanning Tunneling Microscope (STM)-Surface enhanced Raman spectroscopy (SERS)-X-ray Photoelectron Spectroscopy (XPS) -Auger electron spectroscopy (AES).

UNIT-V:APPLICATIONS 9

Solar energy conversion and catalysis -Molecular electronics and printed electronics –Nanoelectronics -Polymers with a special architecture -Liquid crystalline systems - optical properties, Applications in displays and other devices -Photonics, Plasmonics- Chemical and biosensors –Nanomedicine and Nanobiotechnology –Nanotoxicology challenges.

TOTAL: 45 PERIODS

OUTCOMES

- Able to understand the basics of nanoscience.
- Able to differentiate the materials based on their structures.

- Ability to understand the different synthesis techniques of nanomaterials.
- Ability to identify various fabrication techniques and characterization of nanostructures.
- Able to apply them for suitable applications.

TEXT BOOKS:

1. Bhusan, Bharat (Ed), “Springer Handbook of Nanotechnology”, 2nd Edition, 2007.
2. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, AcademicPress, 2002.
3. Pradeep T., “A Textbook of Nanoscience and Nanotechnology”, Tata McGraw Hill Education Pvt. Ltd., 2012.

REFERENCE BOOKS:

1. Charles P. Poole Jr., Frank J. Ownes, ‘Introduction to Nanotechnology”, Wiley Interscience, 2003.
2. Dupas C., Houdy P., Lahmani M., “Nanoscience: Nanotechnologies and nanophysics”,Springer-Verlag Berlin Heidelberg, 2007.
3. Mark Ratner and Daniel Ratner, “Nano Technology”, Pearson Education, New Delhi, 2003.
4. Nabok A., “Organic and Inorganic Nanostructures”, Artech House, 2005.

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1920502 **MICROSCOPY** **L T P C**

3 0 0 3

OBJECTIVES

- To introduce the basic principles of optical and electron microscopy.
- To elucidate the different microscopic techniques.
- To explore the knowledge on electron microscopy
- Make the students to learn the sample preparation techniques for the micro structural analysis.
- To investigate on different chemical analysis techniques.

UNIT- I: INTRODUCTION **9**

History of Microscopy, Overview of current microscopy techniques. Light as particles and waves, Fundamental of optics: Diffraction and interference in image formation, real and virtual images, Resolution, Depth of field and focus, Magnification, Numerical aperture, Aberration of lenses. Components of Light Microscopy, Compound light microscopy and its variations**.**

UNIT- II: MICROSCOPY **9**

Phase contrast microscopy: optical design, theory, image interpretation, Dark-field microscopy: optical design, theory, image interpretation, Polarization Microscopy: Polarized light, optical design, theory, image interpretation, Differential Interference Contrast (DIC): equipment and optics, image interpretation, Modulation contrast microscopy: contrast methods using oblique illumination.

UNIT- III: ELECTRON MICROSCOPY **9**

Interaction of electrons with matter, elastic and inelastic scattering, secondary effects, Components of electron microscopy: Electron sources, pumps and holders, lenses, apertures, and resolution. Scanning Electron and Transmission Electron Microscopy: Principle, construction, applications and limitations.

UNIT- IV: SAMPLE PREPARATION FOR MICROSTRUCTURAL ANALYSIS 9

Optical Microscopy sample preparation: Grinding, polishing and etching, SEM sample preparation: size constrains, TEM sample preparation: Disk preparation, electro polishing, ion milling, lithography, storing specimens.

UNIT-V: CHEMICAL ANALYSIS 9

Surface chemical composition (Principle and applications) - Mass spectroscopy and X-ray emission spectroscopy - Energy Dispersive Spectroscopy- Wave Dispersive Spectroscopy. Electron spectroscopy for chemical analysis (ESCA), X ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES)- Applications.

TOTAL: 45 PERIODS

OUTCOMES

- Able to understand the physics behind the microscopy.
- Ability to describe the principle, construction and working of light microscopy.
- Ability to describe electron microscopy.
- Ability to understand about the important of sample preparation technique.
- Ability to identify the appropriate spectroscopy technique for chemical analysis.

TEXT BOOKS:

1. Douglas B. Murphy, Fundamentals of light microscopy and electronic imaging, 2001, Wiley- Liss, Inc. USA
2. David B. Williams and C. Barry Carter, Transmission Electron Microscopy-A Textbook for Materials Science, Springer US, 2nd edition, 2009.

REFERENCE BOOKS:

1. Brandon D. G, “Modern Techniques in Metallography”, Von Nostrand Inc. NJ, USA,1986.
2. Whan R E (Ed), ASM Handbook, Volume 10, Materials Characterization“, Ninth Edition, ASM international, USA, 1986.

3. Thomas G., “Transmission electron microscopy of metals”, John Wiley, 1996.

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OPEN ELECTIVE II

SEMESTER VII

1903706 GREEN BUILDING DESIGN L T P C

3 0 0 3

OBJECTIVES:

- To develop buildings which use the natural resources to the minimal at the time of construction as well as operation.
- To ensure minimum negative impact on the environment by the construction and operation of a building.
- To gain knowledge on natural lighting and temperature control.
- To develop a design to further reduce the carbon footprint as well as reduce cost of operation.
- To preserve the external environment to the building location.

UNIT- I: ENVIRONMENTAL IMPLICATIONS OF BUILDINGS 9

Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings.

UNIT- II: IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS 9

Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

UNIT- III: COMFORTS IN BUILDING 9

Thermal Comfort in Buildings – Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings – Implications of Geographical Locations.

UNIT- IV: UTILITY OF SOLAR ENERGY IN BUILDINGS **9**

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

UNIT- V: GREEN COMPOSITES FOR BUILDINGS **9**

Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

TOTAL: 45 PERIODS

OUTCOMES:

The students completing the course will have ability to

- Describe the concepts of sustainable design and green building techniques including energy efficiency and indoor environmental quality management.
- Create drawings and models of their own personal green building project.
- Reducing waste, pollution and environmental degradation.
- Efficiently using energy, water, and other resources.
- Protecting occupant health and improving employee productivity.

TEXT BOOKS:

1. K.S.Jagadish, B. U. Venkatarama Reddy and K. S. Nanjunda Rao. "Alternative Building Materials and Technologies". New Age International, 2007.
2. "Low Energy Cooling For Sustainable Buildings". John Wiley and Sons Ltd, 2009.
3. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCE BOOKS:

1. Osman Attmann, Green Architecture Advanced Technologies and Materials, McGraw Hill, 2010.
2. Jerry Yudelson, Green building Through Integrated Design, McGraw Hill, 2009.

3. Fundamentals of Integrated Design for Sustainable Building by Marian Keeler, Bill Burke.

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1903716 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT L T P C

3 0 0 3

OBJECTIVES:

- To impart the knowledge of screening of environmental and social assessment.
- To gain the knowledge of methods for impact assessment.
- To mitigate the environmental and social impacts of developmental projects.
- To develop knowledge on Assessment of Impact on land, water, air, noise and energy, flora and fauna.
- To study on report preparation of EIA.

UNIT- I: INTRODUCTION 9

Impacts of Development on Environment – Rio Principles of Sustainable Development Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework–Stakeholders and their Role in EIA– Selection & Registration Criteria for EIA Consultants

UNIT-II: ENVIRONMENTAL ASSESSMENT 9

Screening and Scoping in EIA – Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction – Analysis of alternatives.

UNIT- III: ENVIRONMENTAL MANAGEMENT PLAN **9**

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Review of EIA Reports – Addressing the issues related to the Project Affected People -Environmental Clearance Post Project Monitoring.

UNIT- IV: SOCIO ECONOMIC ASSESSMENT **9**

Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit Analysis.

UNIT- V: CASE STUDIES **9**

EIA case studies pertaining to Infrastructure Projects – Real Estate Development - Roads and Bridges – Multi-storey Buildings Mass Rapid Transport Systems - Ports and Harbor – Airports - Dams and Irrigation projects - Power plants – Water supply and drainage projects- Waste water treatment plants, STP – Mining Projects.

TOTAL: 45 PERIODS

OUTCOMES:

The students completing the course will have ability to

- Carry out scoping and screening of developmental projects for environmental and social assessments.
- To explain different methodologies for environmental impact prediction and assessment.
- Plan environmental impact assessments and environmental management plans.
- Evaluate environmental impact assessment reports.

- Analyse case studies on various projects.

TEXTBOOKS:

1. Canter, R.L, "Environmental impact Assessment", 2nd Edition, McGraw Hill Inc, New Delhi, 1995.
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, "Environmental Impact Assessment for Developing Countries in Asia", Volume 1 – Overview, Asian Development Bank,1997.
3. Peter Morris, Riki Therivel "Methods of Environmental Impact Assessment", Routledge Publishers, 2009.

REFERENCE BOOKS:

1. Becker H. A., Frank Vanclay ,"The International handbook of social impact assessment" conceptual and methodological advances, Edward Elgar Publishing, 2003.
2. Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme, 2002.
3. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I and II", Blackwell Science New York, 1998.
4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.

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1921701 WASTE WATER TREATMENT L T P C

3 0 0 3

OBJECTIVES

- To make the student conversant with the water treatment methods including adsorption and oxidation process.
- To provide basic under standings about the requirements of water and its preliminary treatment.
- To study the dynamic processes and understand the features of corrosion and its effects.
- To develop and understand the waste water treatment process.
- To provide a broad view about the water quality and its standards.

UNIT-I:WATER QUALITY AND PRELIMINARY TREATMENT 9

Water Quality-physical-chemical and biological parameters of water-Water quality requirement - potable water standards-Wastewater effluent standards-water quality indices. Water purification systems in natural systems- physical processes-chemical processes and biological processes-Primary, secondary and tertiary treatment-Unit operations-unit processes. Mixing, clarification-sedimentation; Types-aeration and gas transfer-coagulation and flocculation, coagulation processes.

UNIT-II: INDUSTRIAL WATER TREATMENT 9

Filtration-size and shape characteristics of filtering media-sand filters hydraulics of filtration-design considerations-radial, upflow, high rate and multimedia filters, pressure filter. Water softening-lime soda, zeolite and demineralization processes – Boiler troubles-scale, sludge, priming, foaming, caustic embrittlement and boiler corrosion.

UNIT-III: CONVENTIONAL TREATMENT METHODS 9

Taste and odour control-Adsorption-activated carbon treatment-removal of color-iron and manganese removal-aeration, oxidation, ion exchange and other methods-effects

of fluorides-fluoridation and defluoridation-desalination-Corrosion prevention and control-factors influencing corrosion-Langelier index-Corrosion control measures.

UNIT-IV: WASTEWATER TREATMENT **9**

Wastewater treatment-pre and primary treatment-equalization neutralization-screening and grid removal-sedimentation-oil separation gas stripping of volatile organics- biological oxidation-lagoons and stabilization basins-aerated lagoons-activated sludge process-trickling filtration-anaerobic decomposition-Break point chlorination.

UNIT-V: ADSORPTION AND OXIDATION PROCESSES **9**

Chemical process-Adsorption-theory of adsorption-Ion exchange process-chemical oxidation- advanced oxidation process-sludge handling and disposal-Miscellaneous treatment processes.

TOTAL: 45 PERIODS

OUTCOMES

At the end of the course, the student should be able to:

- Gain idea about various methods available for water treatment.
- Appreciate the necessity of water and acquire knowledge of preliminary treatment.
- Interpret the nature of corrosion and its harmful effects.
- Value the various waste water treatment methods.
- Understand about adsorption and oxidation process.

TEXTBOOKS:

1. Metcalf and Eddy, “Wastewater Engineering”, 4th ed., McGraw Hill Higher Edu., 2002.
2. G.L.Karia and R.A. Christian, Waste Water Treatment, Concepts and Design Approach, Prentice Hall, 2013.

3. Joanne E. Drinon and Frank Spellman, Water and Waste Water Treatment, CRC Press, 2012.

REFERENCE BOOKS:

1. S.P. Mahajan, “Pollution control in process industries”, 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.
2. M. Lancaster, “Green Chemistry: An Introductory Text”, 2nd edition, RSC publishing, 2010.
3. C.S. Rao, “Environmental Pollution Control Engineering”, New Age International, 2007.
4. M.J. Hammer and M.J. Hammer (Jr.), Water and Waste Water Technology, Pearson, 2011.

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1904703 TAMIL COMPUTING L T P C

3 0 0 3

OBJECTIVES:

- To understand the Tamil grammar and programming basics for Tamil computing.
- To understand the various types of Tamil Computing applications.

- To make the students understand the use of Tamil computing tools and Resources.
- To strengthen the students' ability to carry out the Computational Linguistics in Tamil computing.
- To understand the concepts of Tamil text processing using open – Tamil python library.

UNIT - I:TAMIL GRAMMAR **9**

Alphabets: Classification & Properties - Words: classification and components - Sentences: Structures and word ordering.

UNIT - II: PROGRAMMING BASICS FOR TAMIL COMPUTING **9**

History of Tamil Computing - Standards & Fonts - UNICODE - Object Oriented Tamil Computing -Tamil text processing using open-tamil python library.

UNIT - III: COMPUTATIONAL LINGUISTICS **9**

Basic linguistics - Phonology – Phonology computing – Tholkappiar's Morphological pattern– lexicography – syntax – semantics – pragmatics, Languages for specific purpose & disconise computing

UNIT - IV: TAMIL COMPUTING TOOLS & RESOURCES **9**

POS Tagger - Morphological Analyser - Morphological Generator - Sentence Parser - Named Entity Recognizer - Word Sense Disambiguator - Ontologies – Universal Networking Language & UNL Enconvertor.

UNIT - V: TAMIL COMPUTING APPLICATIONS **9**

Machine Translation – Speech : Synthesis & Processing - Information : retrieval & Extraction – Question Answering – Text Summarization – Automatic Indexing – Text Mining – Conceptual Search.

TOTAL: 45 PERIODS

OUTCOMES:

- Explain classification of Tamil grammar and properties
- Adopt a suitable process for tamil computing tools.
- Analyze the different types of computational linguistics such as phonology, Morphology, lexicography.
- Perform and analyze the Tamil computing applications.
- Analyze and process the Tamil python library.

TEXT BOOKS:

1. The Oxford Handbook of Computational Linguistics, Edited by RuslanMitkov, Oxford University Press, 2014.

REFERENCE BOOKS:

1. Translation - Theory and Application, Valarmathi, International Institute of Tamil Studies, First Edition, 2001.
2. Tholkaappiyam - Thodariyal, Shanmugam, International Institute of Tamil Studies, First Edition, 2004.
3. Tholkaappiyam: Phonology & Morphology, Albert, International Institute of Tamil Studies, First Edition, 1985.
4. Natural language processing and computational linguistics, Bhargav Srinivasa-Desikan Packt Publishing, first edition 2018.
5. The Phonology and morphology of tamil chrisdas Prathima, 2016.
6. Pos Tasser R Morphological Analzser Shodhganga inflibnet.ac.in
7. A tamil Programming language ayxiv.org, muthiah Annamalai.

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1904010 OBJECT ORIENTED PROGRAMMING L T P C

3 0 0 3

OBJECTIVES:

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads and generics classes
- To design and build simple Graphical User Interfaces

UNIT- I: INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 9

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java – The Java Environment - Java Source File - Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays , Packages - JavaDoc comments**.**

UNIT-II: INHERITANCE AND INTERFACES 9

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Strings.

UNIT- III: EXCEPTION HANDLING AND I/O 9

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing

Files.

UNIT- IV: MULTITHREADING **9**

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups.

UNIT- V: EVENT DRIVEN PROGRAMMING **9**

Graphics programming - Frame – Components - working with 2D shapes - Using color,fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to:

- Develop Java programs using OOP principles.
- Develop Java programs with the concepts inheritance and interfaces.
- Build Java applications using exceptions and I/O streams.
- Develop Java applications with threads and generics classes.
- Develop interactive Java programs using swings.

TEXT BOOKS:

1. Herbert Schildt, ―Java The complete reference‖, 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, ―Core Java Volume –I Fundamentals‖, 9th Edition, Prentice Hall, 2013.

REFERENCE BOOKS:

1. Paul Deitel, Harvey Deitel, ―Java SE 8 for programmers‖, 3rd Edition, Pearson, 2015.
2. Steven Holzner, ―Java 2 Black book‖, Dreamtech press, 2011.
3. Timothy Budd, ―Understanding Object-oriented programming with Java‖, Updated Edition, Pearson Education, 2000.

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1904712 SOFTWARE ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To understand the phases in a software development project.
- To understand the concepts of requirements analysis and modeling.
- To understand software design methodologies.
- To learn various testing methodologies.
- To be familiar with issues related to software maintenance.

UNIT –I: SOFTWARE PROCESS 9

Introduction to Software Engineering, scope – software crisis – principles of software engineering- Software process – Life cycle models – Traditional and Agile Models - Team organization.

UNIT- II: PLANNING AND ESTIMATION 9

Planning and the software process – cost estimation: LOC, FP Based Estimation, COCOMO I & II Models – Duration estimation and tracking – Gantt chart - Software Project Management – plan – risk analysis and management.

UNIT- III: REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and Non-Functional, Software Requirements specification– Structured system Analysis – modeling: UML based tools, DFD - Requirement Engineering Process.

UNIT- IV: SOFTWARE DESIGN AND IMPLEMENTATION 9

Design process – Design principles and guidelines – design techniques – coupling and cohesion - metrics – tools. Implementation: choice of programming language, programming practices – coding standards – code walkthroughs and inspections.

UNIT –V: TESTING AND MAINTENANCE 9

Software testing fundamentals- Testing techniques: white box, black box, glass box testing - unit testing – integration testing –system testing – acceptance testing – debugging. Post-delivery maintenance: Types – objectives - metrics - Reverse Engineering.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course, the students will be able to understand different software life cycle models.
- Perform software requirements analysis.
- Apply systematic methodologies for software design and deployment.
- Understand various testing approaches and maintenance related issues.
- Plan project schedule, and estimate project cost and effort required.

TEXT BOOKS:

1. Roger S. Pressman, “Software Engineering – A Practitioner‟ s Approach”, Seventh Edition, Mc Graw-Hill International Edition, 2010.
2. Ian Sommerville, “Software Engineering”, 9th Edition, Pearson Education Asia, 2011.

REFERENCE BOOKS:

1. Rajib Mall, “Fundamentals of Software Engineering”, Third Edition, PHI Learning Private Limited, 2009.
2. Pankaj Jalote, “Software Engineering, A Precise Approach”, Wiley India, 2010.
3. Kelkar S.A., “Software Engineering”, Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, “Software Engineering”, Tata McGraw-Hill Publishing CompanyLimited,2007.
5. http://nptel.ac.in/.

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1906705 **ACOUSTICS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To learn the origin of sound.
- To understand the knowledge in sound propagation.
- To enhance the concepts in Sound analysis.
- To acquire basic knowledge in Physiological acoustics.
- To enable the student to understand the analysis of acoustics.

UNIT - I: INTRODUCTION **9**

Origin of sound. Objective and subjective sound. Sound vibrations, Amplitude, form, and period. Sound waves and their wavelength and speed. Sound pressure level. Energy parameters of sound. Dynamical range. Sound envelope, Sound frequency, Relation between frequency and period.

UNIT - II: PROPAGATION OF SOUND **9**

Sound propagation. Spherical and plane waves. Change of intensity of a propagating sound wave. Sound reflections, echo, absorption, diffraction, refraction. Relation

between pitch and frequency. Pitch standard. Sound spectrum. Types of Public Addressing system. Hi.fi speakers. Microphones: types and its applications.

UNIT - III: SOUND ANALYSIS **9**

Natural scales. Origin of musical scale. Tonal material and modal scale. Pythagorean tuning, Temperaments. Non-equal temperaments. Equal temperaments. Relation of musical scale and kind of music. Sound Pre-Processing and analysis, Audio analysis tools.

UNIT - IV: PHYSIOLOGICAL ACOUSTICS **9**

Physiological and psychological acoustics. Loudness. Loudness level. Fletcher-Munson diagram. Range of hearing. Masking. Compression of sound information, Pitch, timbre, subjective duration. Absolute pitch. Acoustics instruments. Peripheral auditory system.

UNIT - V: ACOUSTICAL ANALYSIS **9**

Sound phenomena in rooms. Direct sound. Early reflections. Reverberation and its formation, Criteria for good acoustics of a room and methods of their realization, Reverberation time. Dependence of reverberation time on room volume and surfaces (area and absorption), Evaluation of reverberation time. Optimal reverberation times for various types of music and room sizes.

TOTAL: 45 PERIODS

OUTCOMES:

The student should be able to:

- Analyze the basic parameters of sound.
- Understand the effects of propagation.
- Know the basic functions of sound analysis.
- Derive the output using Physiological acoustics.
- Acquire the knowledge on the Applications of acoustics.

TEXT BOOKS:

1. Rossing T. D., Moore R. F., Wheeler P. A.," The Science of Sound", 3rd edition San Francisco: Addison Wesley, 2002.
2. Hall D. E.," Musical Acoustics", 3rd edition Pacific Grove, CA: Brooks/Cole, 2001.
3. Howard D. M., Angus J. A. S.," Acoustics and psychoacoustics", 5th edition New York, London: Routledge, 2017.

REFERENCE BOOKS:

1. Everest F. A., Pohlmann K. C.," Master Handbook of Acoustics", 5th edition New York: McGraw-Hill, 2001.
2. Rossing T. D., ed.," Springer Handbook of Acoustics", 2nd edition Berlin, Heidelberg: SpringerVerlag 2014.
3. Chakrabarti, Pradip Kumar and Chowdhury, Satyabrata, "A Textbook on Waves and Acoustics", New Central book agency, 2010.

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1906706 VISUAL COMMUNICATION L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To know about the basics of communication.
- To learn and acquire the art of visual communication.
- To understand and relate the importance of visual communication.

- To gain knowledge about the basic of Visual Communication.
- To acquire idea and concepts of various forms of Media

UNIT - I: INTRODUCTION **9**

Need for and the Importance of Human and Visual Communication. Communication a expression, skill and process, Understanding Communication: SMRC-Model.

UNIT - II: PROCESS IN COMMUNICATION **9**

Communication as a process. Message, Meaning, Connotation, Denotation Culture/Codes etc Levels of communication: Technical, Semantic, and Pragmatic. The semiotic landscape: language and visual communication, narrative representation

UNIT - III: METHODOLOGY **9**

Fundamentals of Design: Definition. Approaches to Design, Centrality of Design, EIements/Elements of Design: Line, Shape, Space, Color, Texture. Form Etc. Principles of Design: Symmetry. Rhythm, Contrast, Balance Mass/Scale etc. Design and Designers (Need, role, process, methodologies etc.).

UNIT - IV: DESIGN PROCESS **9**

Principles of Visual and other Sensory Perceptions. Color psychology and theory (some aspects) Definition, Optical / Visual Illusions Etc., Various stages of design process-problem identification, search for solution refinement, analysis, decision making, Implementation.

UNIT - V: GRAPHIC DESIGN **9**

Basics of Graphic Design. Definition, Elements of GD, Design process-research, a source of concept, the process of developing ideas-verbal, visual, combination & thematic, visual thinking, associative techniques, materials, tools (precision instruments etc.) design execution, and presentation.

TOTAL: 45 PERIODS

OUTCOMES:

The student should be able to:

- Learn about the history & evolution of Communication.
- Understand the Nature & functions of Visual Communication.
- Acquire knowledge on different types of perception & illusion.
- Get knowledge on semiotics.
- Remember the world of ideation creating.

TEXT BOOKS:

1. Lester, E, “Visual Communications: Images with Messages”, Thomson Learning, 2013.
2. Jonathan Baldwin, “Visual Communication: From Theory to Practice”, AVA publishing, 2006.

REFERENCE BOOKS:

1. Schildgen, T., “Pocket Guide to color with digital applications”, Thomsom Learning, 2000.
2. Palmer, Frederic, “Visual Elements of Art and Design”, Longman, 1990.
3. Carter, “Typographic Design : Form and Communication”, 6/e, John Wiley, 2014.

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1906707	MEMS AND NEMS	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made:

- To introduce the concepts of micro and nano electromechanical devices.
- To know the fabrication process of microsystems.
- To know the design concepts of micro sensors.
- To understand the design of various micro actuators.
- To introduce the concepts of quantum mechanics and nano systems.

UNIT – I: INTRODUCTION TO MEMS AND NEMS **9**

Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.

UNIT – II: MEMS FABRICATION TECHNOLOGIES **9**

Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA, Micromolding.

UNIT – III: MICRO SENSORS **9**

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester.

UNIT – IV: MICRO ACTUATORS **9**

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch.

UNIT – V: NANO DEVICES **9**

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor.

TOTAL: 45 PERIODS

OUTCOMES:

After studying this course, the student should be able to,

- Interpret the basics of micro/nano electromechanical systems including their applications and advantages.
- Recognize the use of materials in micro fabrication and describe the fabrication processes including surface micromachining, bulk micromachining and LIGA.
- Analyze the key performance aspects of electromechanical sensors.
- Illustrate the design of micro actuators using various actuations.
- Comprehend the theoretical foundations of quantum mechanics and Nano systems.

TEXT BOOKS:

1. Marc Madou, “Fundamentals of Microfabrication”, CRC press 1997.
2. Stephen D. Senturia, “Micro system Design”, Kluwer Academic Publishers, 2001.

REFERENCES BOOKS:

1. Tai Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata McGraw Hill, 2002.
2. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006.
3. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures”, CRC Press, 2002.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

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1905711 ELECTRICAL CIRCUITS L T P C

3 0 0 3

OBJECTIVES:

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To introduce Phasor diagrams of three phase circuits
- To analysis the three phase circuits

UNIT-I: BASIC CIRCUITS ANALYSIS 9

Resistive elements - Ohm's Law Resistors in series and parallel circuits – Kirchhoff's laws – Mesh current and node voltage - methods of analysis.

UNIT-II: NETWORK REDUCTION AND THEOREMS FOR DC CIRCUITS 9

Network reduction: voltage and current division, source transformation – star delta conversion. Theremins' and Norton Theorems – Superposition Theorem – Maximum

power transfer theorem –Reciprocity Theorem – Millman's theorem.

UNIT-III: AC CIRCUITS **9**

Introduction to AC circuits, inductance reactance, capacitive reactance, Phasor diagrams, real power, reactive power, apparent power, power factor, R-L R-C , RLC networks, Network reduction: voltage and current division, source transformation – mesh and node analysis, Theremins' and Norton Theorems – Superposition Theorem – Maximum power transfer theorem –Reciprocity Theorem – Millman's theorem.

UNIT-IV: THREE PHASE CIRCUITS **9**

A.C. circuits – Average and RMS value - Phasor Diagram – Power, Power Factor and Energy.-Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

UNIT-V: RESONANCE AND COUPLED CIRCUITS **9**

Series and parallel resonance – their frequency response – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits – SMPS.

OUTCOMES:

- Ability to introduce electric circuits and its analysis
- Ability to impart knowledge on solving circuit equations using network theorems.
- Ability to introduce the phenomenon of resonance in coupled circuits.
- Ability to introduce Phasor diagrams of three phase circuits
- Ability to analysis of three phase circuits

TEXTBOOKS:

1.William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits

Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2013.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCE BOOKS:

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., "Analysis of Electric Circuits," McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum"s series, McGraw-Hill, New Delhi, 2010.
4. M E Van Valkenburg, "Network Analysis",Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley & Sons, Inc. 2015
6. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", McGraw Hill, 2015.

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1905712	RENEWABLE ENERGY SYSTEMS	L	T	P	C
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OBJECTIVES:

- About the stand alone and grid connected renewable energy systems. .
- Design of power converters for renewable energy applications.
- Wind electrical generators.
- Solar energy systems.
- Power converters used for renewable energy systems.

UNIT-I: INTRODUCTION **9**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT-II: ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION **9**

Reference theory fundamentals-principle of operation and analysis: IG and PMSG.

UNIT-III: POWER CONVERTERS **9**

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers

UNIT-IV: ANALYSIS OF WIND AND PV SYSTEMS **9**

Stand alone operation of fixed and variability speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system.

UNIT-V: HYBRID RENEWABLE ENERGY SYSTEMS 9

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to handle the engineering aspects of electrical energy generation and utilization.
- Ability to understand the stand alone and grid connected renewable energy systems.
- Ability to design of power converters for renewable energy applications.
- Ability to acquire knowledge on wind electrical generators and solar energy systems.

TEXTBOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.

2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company New Delhi, 2009.

REFERENCE BOOKS:

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.

2. Ion Boldea, “Variability speed generators”, Taylor & Francis group, 2006.

3. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.

4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.

5. Andrzej M. Trzynnadlowski, „Introduction to Modern Power Electronics", Second edition, wiley India Pvt. Ltd, 2012.

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1905713 ELECTRIC VEHICLES AND POWER MANAGEMENT **L T P C**

3 0 0 3

OBJECTIVES:

To impart knowledge on the following Topics

- To understand the concept of electrical vehicles and its operations.
- To provide knowledge about Power train components.
- To understand the various Control strategies in AC and DC drives.
- To understand the need for energy storage in hybrid vehicles.
- To provide knowledge about alternative energy storage technologies that can be used in electric vehicles.

UNIT-I: ELECTRIC VEHICLES AND VEHICLE MECHANICS 9

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings, Comparisons of EV with internal combustion Engine vehicles, Fundamentals of vehicle mechanics – EV Testing.

UNIT-II: ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS 9

Architecture of EV's and HEV's – Plug-n Hybrid Electric Vehicles (PHEV) - Standards - Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT-III: CONTROL OF DC AND AC DRIVES **9**

DC/DC chopper based four quadrant operations of DC drives – Inverter based V/f Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor-based vector control operation – Switched reluctance motor (SRM) drives.

UNIT-IV: BATTERY ENERGY STORAGE SYSTEM **9**

Battery Basics, Different types, Battery Parameters, Battery modeling, Traction Batteries, Energy management system in Electric vehicle – Battery Management Systems.

UNIT-V: ALTERNATIVE ENERGY STORAGE SYSTEMS **9**

Fuel cell – Characteristics- Types – hydrogen Storage Systems and Fuel cell EV – Ultra Capacitors

TOTAL : 45 PERIODS

OUTCOMES:

- Learners will understand the operation of Electric vehicles and Hybrid Electric vehicles.
- Learners will gain knowledge on Power train components.
- Learners can analyze the control strategies in AC and DC drives.
- Learners will gain knowledge on various energy storage technologies for electrical vehicles.
- Learners know about alternative energy storage technologies for electric vehicles.

TEXTBOOKS:

1. Iqbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals, Second Edition**”** CRC Press, Taylor & Francis Group, Second Edition (2011).
2. Ali Emadi, Mehrdad Ehsani, John M.Miller, “Vehicular Electric Power Systems” , Special Indian Edition, Marcel dekker, Inc 2010.

3. James Larminie and John Loury, “Electric Vehicle Technology – Explained”, John Wiley & Sons Ltd, 2003.

REFERENCE BOOKS:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel cell Vehicles” CRC Press, Taylor & Francis Group, Second Edition (2010).
2. Emanuele Crisostomi, Robert Shorten, SonjaStudli & Fabian Wirth “Electric and Plug-in Hybrid Vehicle Networks” Taylor & Francis group 2018.
3. Ronald K Jurgen, “Electric and Hybrid – Electric Vehicles”, SAE, 2002.

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1907001 TRANSDUCERS ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To make the students to know the methods of measurement, classification of transducers and to analyze error.
- To make the students to understand the behavior of transducers under static and dynamic conditions and hence to model the transducer.
- To expose the students to different types of resistive transducers and their

application areas.

- To make the students to acquire knowledge on capacitive and inductive transducers.
- To impart knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

UNIT –I: SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS **9**

Units and standards – Static calibration – Classification of errors–Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT – II: CHARACTERISTICS OF TRANSDUCERS **9**

Static characteristics: - Accuracy, precision, resolution, sensitivity, linearity. Dynamic characteristics: Mathematical model of transducer, Zero, I and II order transducers, Response to impulse, step, ramp and sinusoidal inputs.

UNIT – III: VARIABLE RESISTANCE TRANSDUCERS **9**

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

UNIT – IV: VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS **9**

Inductive transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – EI pickup-– Principle of operation, construction details, characteristics of capacitive transducers - Capacitor microphone, Proximity sensor.

UNIT – V: OTHER TRANSDUCERS **9**

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Smart transducers - Fiber optic sensors – Thick & Thin Film sensors (Bio sensor & Chemical Sensor) – Nano sensors

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student will be able to:

- Apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications.
- Analyze the problems related to sensors & transducers.
- Select the right sensor/transducer for a given application.
- Determine the static and dynamic characteristics of transducers
- Understand fiber optic sensor, smart transducers and their applications.

TEXT BOOKS:

1. Doebelin E.O. and Manik D.N., “Measurement Systems”, 7th Edition, McGraw-Hill Education Pvt. Ltd., 2019.
2. A. K. Sawhney, “A Course in Electrical & Electronic Measurements & Instrumentation”, Dhanpat Rai and Co, New Delhi, 2015.

REFERENCE BOOKS:

1. Bela G.Liptak, “Instrument Engineers' Handbook, Process Measurement and Analysis”, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
2. D. Patranabis, “Sensors and Transducers”, 2nd edition, Prentice Hall of India, 2010.
3. E.A. John P. Bentley, “Principles of Measurement Systems”, 4th Edition, Pearson Education,2004.
4. W.Bolton, “Engineering Science”, Elsevier Newnes, Fifth edition, 2006.
5. Murthy, D.V.S., “Transducers and Instrumentation”, 2nd Edition, Prentice Hall of

India Pvt. Ltd., New Delhi, 2008.

6. S.Ranganathan, “Transducer Engineering”, Allied Publishers Pvt. Ltd., 2003.

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1907003 PROCESS MODELING AND SIMULATION L T P C

3 0 0 3

OBJECTIVES:

- To give an overview of various methods of process modeling, different computational techniques for simulation.
- To analyze the simulation for steady state lumped system.
- To analyze the simulation for unsteady state lumped system.
- To analyze the simulation for steady state distributed system.
- To analyze the simulation for unsteady state distributed system.

UNIT - I : INTRODUCTION 9

Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT - II:STEADY STATE LUMPED SYSTEMS 9

Degree of freedom analysis, single and network of process units, systems yielding linear and nonlinear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.

UNIT – III: UNSTEADY STATE LUMPED SYSTEMS 9

Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.

UNIT - IV : STEADY STATE DISTRIBUTED SYSTEM 9

Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT - V : UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES 9

Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor. Empirical modeling, parameter estimation, population balance and stochastic modeling.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student will be able to:

- Develop the process models based on Conservation principles and Process data.
- Understand the characteristics of state lumped systems.
- Understand the characteristics of state distributed lumped systems.
- Carry out the analysis and design empirical modeling of systems.
- Apply computational techniques to solve the process models.

TEXT BOOKS:

1. Ramirez, W.; “Computational Methods in Process Simulation “, 2nd Edn, Butterworths Publishers, New York, 2000.
2. Luyben, W.L., “ Process Modelling Simulation and Control“, 2nd Edn, McGraw-Hill Book Co.,1990.

REFERENCE BOOKS:

1. Felder, R. M. and Rousseau, R. W., “Elementary Principles of Chemical Processes”, John Wiley, 2000.
2. Franks, R. G. E., “Mathematical Modelling in Chemical Engineering”, John Wiley, 1967.
3. Amiya K. Jana, ”Process Simulation and Control Using ASPEN”, Second Edition, PHI Learning Ltd, 2012.
4. Amiya K. Jana, ”Chemica lProcess Modelling and Computer Simulation” Second Edition, PHI Learning Ltd, 2012.

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1907708 STATE VARIABLE ANALYSIS AND DESIGN L T P C

3 0 0 3

OBJECTIVES:

- To provide knowledge on design in state variable form.

- To study the design of state variable.
- To study the design of state estimator.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter.

UNIT – I: STATE FORMULATION **9**

Formulation of state variable model, non-uniqueness, controllability, observability, stability.

UNIT – II: STATE VARIABLE DESIGN **9**

Modes, controllability of modes -effect of state and output Feedback- pole placement Design.

UNIT – III: STATE ESTIMATION **9**

Need for state estimation - design of state Observers - full and reduced order - disturbance estimation - separation principle.

UNIT – IV: OPTIMAL CONTROL **9**

Introduction - Time varying optimal control - LQR steady state optimal control - Solution of Ricatti's equation - Application examples.

UNIT – V: OPTIMAL ESTIMATION **9**

Optimal estimation - Kalman Bucy Filter-Solution by duality principle - Discrete systems - Kalman Filter - Application examples.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student will be able to:

- Apply advanced control theory to practical engineering problems.
- Understand and analyse state variable design.

- Understand and analyse state estimation.
- Understand and analyse optimal controller.
- Understand and analyse optimal estimator.

TEXT BOOKS:

1. K. P. Mohandas, “Modern Control Engineering”, 2nd Edition, Sanguine Technical Publishers, 2016.
2. G. J. Thaler, “Automatic Control Systems”, Jaico Publishing House, 1993.
3. M.Gopal, “Modern Control System Theory”, 3rd Edition, New Age International Publishers, 2014.

REFERENCE BOOKS:

1. William S Levine, “Control System Fundamentals,” The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
2. Ashish Tewari, “Modern Control Design with Matlab and Simulink”, John Wiley, New Delhi, 2002.
3. K. Ogata, “Modern Control Engineering”, 5th Edition, PHI, New Delhi, 2002.
4. T. Glad and L. Ljung,, “Control Theory –Multivariable and Non-Linear Methods”, Taylor & Francis, 2002.
5. D.S.Naidu, “Optimal Control Systems”, First Indian Reprint, CRC Press, 2009.

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1908003 SOFTWARE QUALITY MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To have an introduction to software quality
- To understand software quality assurance.
- To understand about quality control and reliability.
- To understand quality management system.
- To understand about Quality Standards.

UNIT - I: INTRODUCTION TO SOFTWARE QUALITY 9

Software Quality – Hierarchical models of Boehm and McCall – Quality measurement – Metrics measurement and analysis – Gilb's approach – GQM Model.

UNIT - II: SOFTWARE QUALITY ASSURANCE 9

Quality tasks – SQA plan – Teams – Characteristics – Implementation – Documentation – Reviews and Audits..

UNIT - III: QUALITY CONTROL AND RELIABILITY 9

Tools for Quality – Ishikawa's basic tools – CASE tools – Defect prevention and removal– Reliability models – Rayleigh model – Reliability growth models for quality Assessment.

UNIT - IV: QUALITY MANAGEMENT SYSTEM 9

Elements of QMS – Rayleigh model framework – Reliability Growth models for QMS – Complexity metrics and models – Customer satisfaction analysis.

UNIT - V: QUALITY STANDARDS 9

Need for standards – ISO 9000 Series – ISO 9000-3 for software development – CMM and CMMI – Six Sigma concepts.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- To understand introduction about quality measurement.
- To understand SQA plan.

- To understand about Quality assessment.
- To understand about Customer satisfaction analysis.
- To understand Six Sigma Concepts.

TEXT BOOKS:

1. Allan C. Gillies, “Software Quality: Theory and Management”, Thomson Learning, 2003.
2. Stephen H. Kan, “Metrics and Models in Software Quality Engineering”, Pearson Education (Singapore) Pte Ltd., 2002.

REFERENCE BOOKS:

1. Norman E. Fenton and Shari Lawrence Pfleeger, “Software Metrics” Thomson, 2003
2. Mordechai Ben – Menachem and Garry S.Marliss, “Software Quality”, Thomson Asia Pte Ltd, 2003.
3. Mary Beth Chrissis, Mike Konrad and Sandy Shrum, “CMMI”, Pearson Education (Singapore) Pte Ltd, 2003.
4. ISO 9000-3 “Notes for the application of the ISO 9001 Standard to software development”.

CO	PO												PSO			
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1908004 C# and .NET PROGRAMMING L T P C

3 0 0 3

OBJECTIVES:

- To learn basic programming in C# and the object oriented programming concepts.
- To update and enhance skills in writing Windows applications, ADO.NET and ASP .NET.
- To study the advanced concepts in data connectivity, WPF, WCF and WWF with C# and .NET 4.5.
- To implement mobile applications using .Net compact framework.
- To understand the working of base class libraries, their operations and manipulation of data using XML.

UNIT - I: C# LANGUAGE BASICS 9

.Net Architecture – Core C# – Variables – Data Types – Flow control – Objects and Types- Classes and Struts – Inheritance- Generics – Arrays and Tuples – Operators and Casts – Indexers

UNIT - II: C# ADVANCED FEATURES 9

Delegates – Lambdas – Lambda Expressions – Events – Event Publisher – Event Listener – Strings and Regular Expressions – Generics – Collections – Memory Management and Pointers – Errors and Exceptions – Reflection.

UNIT - III: BASE CLASS LIBRARIES AND DATA MANIPULATION 9

Diagnostics -Tasks, Threads and Synchronization – .Net Security – Localization – Manipulating XML- SAX and DOM – Manipulating files and the Registry- Transactions – ADO.NET- Peer-to-Peer Networking – PNRP – Building P2P Applications – Windows Presentation Foundation (WPF).

UNIT - IV: WINDOW BASED APPLICATIONS, WCF AND WWF 9

Window based applications – Core ASP.NET- ASP.NET Web forms -Windows

Communication Foundation (WCF)- Introduction to Web Services – .Net Remoting – Windows Service – Windows Workflow Foundation (WWF) – Activities – Workflows

UNIT - V: .NET FRAMEWORK AND COMPACT FRAMEWORK 9

Assemblies – Shared assemblies – Custom Hosting with CLR Objects – App domains – Core XAML – Bubbling and Tunneling Events- Reading and Writing XAML – .Net Compact Framework – Compact Edition Data Stores – Errors, Testing and Debugging – Optimizing performance – Packaging and Deployment – Networking and Mobile Devices

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Write various applications using C# Language in the .NET Framework.
- Develop programs using advanced C# concepts on .NET
- Analyse the base class libraries, operations and manipulation of data using XML.
- Develop distributed applications using .NET Framework.
- Create mobile applications using .NET compact Framework.

TEXT BOOKS:

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner . —Professional C# 2012 and .NET 4.5, Wiley, 2012
2. Harsh Bhasin, —Programming in C#, Oxford University Press, 2014.

REFERENCE BOOKS:

1. Ian Gariffiths, Mathew Adams, Jesse Liberty, —Programming C# 4.0, OReilly, Fourth Edition, 2010.
2. Andrew Troelsen, Pro C# 5.0 and the .NET 4.5 Framework, Apress publication, 2012.
3. Andy Wigley, Daniel Moth, Peter Foot, —Mobile Development Handbook, Microsoft Press, 2011.

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1908005 **VIRTUAL REALITY** **L T P C**

3 0 0 3

OBJECTIVES:

- To study about basic concepts of Virtual reality.
- To understand Virtual environment.
- To understand geometric modeling.
- To study about Virtual Hardware and Software.
- To develop Virtual Reality applications.

UNIT - I: INTRODUCTION TO VIRTUAL REALITY **9**

Virtual Reality & Virtual Environment : Introduction – Computer graphics – Real time computer graphics–Flight Simulation –Virtual environments–requirement – benefits of virtual reality- Historical development of VR : Introduction – Scientific Landmark -3D Computer Graphics :Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – human vision – stereo perspective projection – 3D clipping – Colour theory – Simple 3D modeling- illumination models – Reflection models – Shading algorithms- Radiosity – Hidden Surface Removal – Realism-Stereographic image.

UNIT - II: GEOMETRIC MODELLING **9**

Geometric Modeling: Introduction – From 2D to 3D – 3D space curves – 3D boundary representation - Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances –Picking – Flying – Scaling the VE – Collision detection - A Generic VR system: Introduction – The virtual environment – the Computer environment – VR Technology – Model of interaction-VR Systems.

UNIT - III: VIRTUAL ENVIRONMENT **9**

Animating the Virtual Environment: Introduction – The dynamics of numbers – Linear and Non-linear interpolation - The animation of objects – linear and non- linear translation - shape & object in between ing – free from deformation – particle system- Physical Simulation : Introduction – Objects falling in a gravitational field-Rotating wheels – Elastic collisions – projectiles – simple pendulum – springs – Flight dynamics of an aircraft.

UNIT - IV: VR HARDWARES & SOFTWARES **9**

Human factors: Introduction – the eye-the ear-the somatic senses-VR Hardware : Introduction – sensor hardware – Head-coupled displays –Acoustic hardware – Integrated VR systems-VR Software: Introduction –Modeling virtual world –Physical simulation- VR toolkits – Introduction to VRML.

UNIT - V: VR APPLICATION **9**

Virtual Reality Applications: Introduction – Engineering – Entertainment – Science Training – The Future: Introduction – Virtual environments – modes of interaction.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understood the basic concept of virtual reality.

- Understood 3D computer Graphics System.
- Design object objects using geometric modeling.
- Develop Virtual environment.
- Apply study about Virtual Hardwares, Softwares and Develop Virtual Reality applications.

TEXT BOOK:

1. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.

REFERENCE BOOKS:

1. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.
2. Grigore C. Burdea, Philippe Coiffet, “Virtual Reality Technology”, Wiley Interscience, 2nd Edition, 2006.
3. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application, and Design”, Morgan Kaufmann, 2008.
4. www.vresources.org.
5. www.vrac.iastate.edu.
6. www.w3.org/MarkUp/VRML.

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1910703	CLINICAL TRIALS	L T P C
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OBJECTIVES:

The student should be made:

- To highlight the epidemiologic methods, study design, protocol preparation.
- To learn about the crossover and factorial trial designs.
- To acquire knowledge in the basic bio-statistical techniques involved in clinical research.
- To describe the principle involved in ethical, legal and regulatory issues in clinical trials.
- To explore the reporting of trials.

UNIT – I: ROLE OF CLINICAL TRIALS IN NEW DRUG DEVELOPMENT 9

Drug Discovery, Regulatory guidance and governance, Pharmaceutical manufacturing, Non-clinical research, Clinical trials, Post-marketing surveillance, Ethical conduct during clinical trials.

UNIT – II: FUNDAMENTALS OF TRIAL DESIGN 9

Randomised clinical trials, Uncontrolled trials. Protocol development, Endpoints, Patient selection, Source and control of bias, Randomization, Blinding, Sample size and power.

UNIT – III: ALTERNATE TRIAL DESIGNS 9

Crossover design, Factorial design, Equivalence trials, Bioequivalence trials, Non-inferiority trials, Cluster randomized trials, Multi-center trials.

UNIT – IV: BASICS OF STATISTICAL ANALYSIS 9

Types of data and normal distribution, Significance tests and confidence intervals, Comparison of means, Comparison of proportions, Analysis of survival data, Subgroup analysis, Regression analysis, Missing data.

UNIT – V: REPORTING OF TRIALS **9**

Overview of reporting, Trial profile, Presenting baseline data, Use of tables, Figures, Critical appraisal of report, Meta-analysis.

TOTAL: 45 PERIODS

OUTCOMES:

The student should be able to:

- Explain key concepts in the design of clinical trials.
- Describe study designs used in data management for clinical trials.
- Identify key issues and determine alternate trial designs.
- Recognize the roles of regulatory affairs in clinical trials.
- Provide the overview of reporting trials.

TEXT BOOKS:

1. Lawrence M. Friedman, “Fundamentals of Clinical Trials”, Springer Science & Business Media, Fifth Edition, 2015.
2. Stuart J. Pocock, “Clinical Trials: A Practical Approach”, John Wiley & Sons, 2013.

REFERENCE BOOKS:

1. David Machin, Simon Day, Sylvan Green, “Textbook of Clinical Trials”, Second Edition, John Wiley & Sons, 2007.
2. Duolao Wang, Ameet Bakhai, “Clinical trials, A practical guide to design, analysis and reporting”, First Edition, Remedica, 2006.
3. T.A. Durham, J Rick Turner, “Introduction to statistics in pharmaceutical clinical trials”, First Edition, Pharmaceutical Press, 2008.
4. Tom Brody, “Clinical Trials: Study Design, Endpoints and Biomarkers, Drug Safety, and FDA and ICH Guidelines”, Second Edition, Academic Press, 2016.

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1910704 REGULATORY REQUIREMENTS IN PHARMACEUTICAL INDUSTRIES **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To acquire knowledge in pharmaceutical industry regulations.
- To learn about the packaging and labeling of drugs.
- To understand the patent filling process.
- To analyze the quality guidelines in drug products.
- To explore the process of documentation.

UNIT - I: REGULATORY CONCEPTS **9**

Quality assurance – Quality control – Practice of cGMP – Schedule M – USFDA.

UNIT – II: REGULATORY ASPECTS **9**

Pharmaceuticals: Bulk drug manufacture; Personnel, Buildings and Facilities, Process Equipment, Documentation and Records, Materials Management, Production and In-Process Controls, Packaging and Identification Labelling of API"s and Intermediates, Storage and distribution, Biotechnology derived products; Principles, Personnel, Premises and equipments, Animal quarters and care, production, labelling, Lot processing records and distribution records, Quality assurance and quality control.

UNIT – III: INTELLECTUAL PROPERTY RIGHTS **9**

Patent system – Different types of patents – Filing process of application for patent – Infringement of patents – The patent rules 2003 as amended by the patents (amendment) rules 2016.

UNIT – IV: ICH GUIDELINES **9**

Quality guidelines – Impurities in new drug substances (Q3A (R2)) – Impurities in newdrug products(Q3B(R2)) – Validation of analytical procedures text and methodology (Q2 (R1)).

UNIT – V: QUALITY AUDIT AND SELF INSPECTIONS **9**

SOPs – Documentation – Loan license auditing – Common technical documentation (CTD) – Drug master file (DMF).

TOTAL: 45 PERIODS

OUTCOMES:

The student should be able to:

- Explain the pharmaceutical industry manufacturing practices and regulatory aspects of pharmacy products.
- Describe the process of patenting activities.
- Assess the different types of patents and filling process.
- Explore the quality guidelines followed for pharmaceutical products.
- Enumerate the aspects involved in document preparation for pharmaceutical product registration.

TEXT BOOKS:

1. C. V. Subbrahmanyam & J. Thimmasetty, “Pharmaceutical regulatory affairs”, First Edition, Vallabh Prakashan, New Delhi, 2012.

2. Willig, H., Tuckerman, M.M. and Hitchings, W.S., “Good Manufacturing Practices for Pharmaceuticals”, Fifth Edition, Marcel Dekker Drugs and the Pharmaceutical Sciences, by CRC Press, New York, 2000.
3. N Udupa, Krishnamurthy Bhat, “A Concise Textbook of Drug Regulatory Affairs”, First Edition, Manipal University Press (MUP); 2015.

REFERENCE BOOKS:

1. Ira R. Berry, “The Pharmaceutical Regulatory Process, marcel dekker Series: Drugs and the Pharmaceutical Sciences”, CRC Press, Newyork, 2004.
2. Mindy J. Allport-Settle, “Current Good Manufacturing Practices: Pharmaceutical, Biologics, and Medical Device Regulations and Guidance Documents Concise Reference”, Pharmalogika Inc., USA, 2009.
3. Sharma, P.P., “How to Practice GMPs”, Third Edition, Vandana Publications, 2006.

CO	PO												PSO			
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4	2	-	-	-	-	2	3	3	-	-	-	2	2	-	-	-
5	2	-	-	-	-	2	3	3	-	-	-	2	2	-	-	-

1910705 MICROBIOLOGY L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the principles of Microbiology.
- To emphasize the structure and biochemical aspects of various microbes.

- To learn about the Nutritional classification of microorganisms.
- To gain knowledge on the physical and chemical control of microorganisms.
- To acquire knowledge about the preservation of food.

UNIT – I: INTRODUCTION TO MICROBIOLOGY **9**

Classification and nomenclature of microorganisms, Microscopic examination of microorganisms: Light, Fluorescent, Dark field, Phase contrast, and Electron microscopy.

UNIT – II: MICROBES- STRUCTURE AND REPRODUCTION **9**

Structural organization and multiplication of bacteria, Viruses (TMV, Hepatitis B), Algae(cyanophyta, rhodophyta) and Fungi (Neurospora), Life history of actinomycetes (Streptomyces), Yeast (Sacharomyces), Mycoplasma (M. pneumoniae) and Bacteriophages (T4 phage, ʎphage)

UNIT – III: MICROBIAL NUTRITION, GROWTH AND METABOLISM **9**

Nutritional classification of microorganisms based on carbon, Energy and electron sources. Definition of growth, Balanced and unbalanced growth, Growth curve and different methods to quantify bacterial growth:(counting chamber, viable count method, counting without equipment),Different media used for bacterial culture (defined, complex, selective, differential, enriched),The mathematics of growth-generation time, Specific growth rate.

UNIT – IV: CONTROL OF MICROORGANISMS **9**

Physical and chemical control of microorganisms, Definition of sterilization, Dry and moist heat, Pasteurization, Tyndalization, Radiation, Ultrasonication, Filtration. Disinfections anitization, Antiseptics sterilants and fumigation. Mode of action and resistance to antibiotics, Clinically important microorganisms.

UNIT – V: INDUSTRIAL MICROBIOLOGY **9**

Microbes involved in preservation (Lactobacillus, bacteriocins), Spoilage of food and food borne pathogens (E.coli, S.aureus, Bacillus, Clostridium). Industrial use of microbes (production of penicillin, alcohol, vitamin B-12); Biogas; Bioremediation (oil spillage leaching of ores by microorganisms, pollution control); Biofertilizers, Biopesticides. Biosensors. Quality assurance – Quality control – Practice of cGMP – Schedule M – USFDA.

TOTAL: 45 PERIODS

OUTCOMES:

The student should be able to:

- Explain the fundamentals of Microbiology.
- Explore the scope of Microbiology.
- Apply knowledge to solve the problems in microbial infection and their control.
- Analyze the concept of food preservation.
- Describe the industrial use of microbes.

TEXT BOOKS:

1. Ananthanarayanan, R. and C.K. Jayaram Paniker, “Textbook of Microbiology”, University Press, Ninth Edition, 2015.
2. Prescott L.M., Harley J.P., Klein DA, “Microbiology”, Eleventh Edition, McGraw - Hill Inc., 2020.

REFERENCE BOOKS:

1. Pelczar, M.J. “Microbiology”, Fifth Edition, Tata McGraw-Hill, 1993.
2. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.
3. Schlegel, H.G. “General Microbiology”, Seventh Edition, Cambridge University Press, 1993.

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

1909718 **ROBOTICS** **L T P C**

3 0 0 3

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understand the functions of robots and review the need and application of robots in different engineering fields.
- Exemplify the different types of robot drive systems as well as robot end effectors.
- Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
- Develop robotic programs for different tasks and analyze the kinematics motions of robot.
- Implement robots in various industrial sectors and interpolate the economic analysis of robots.

UNIT-I: FUNDAMENTALS OF ROBOT **9**

Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT-II: ROBOT DRIVE SYSTEMS AND END EFFECTORS **9**

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT-III: SENSORS AND MACHINE VISION **9**

Requirements of a sensor, Principles and Applications of the following types of sensors-Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data-Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications-Inspection, Identification, Visual Serving and Navigation.

UNIT-IV: ROBOT KINEMATICS AND ROBOT PROGRAMMING **9**

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT-V: IMPLEMENTATION AND ROBOT ECONOMICS **9**

RGV, AGV; Implementation of Robots in Industries -Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Understand the functions of robots and review the need and application of robots in different engineering fields.
- Exemplify the different types of robot drive systems as well as robot end effectors.
- Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
- Develop robotic programs for different tasks and analyze the kinematics motions of robot.
- Implement robots in various industrial sectors and interpolate the economic analysis of robots.

TEXTBOOKS:

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2001.

REFERENCE BOOKS:

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 1994.

3. Koren Y., “Robotics for Engineers", McGraw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”,McGraw Hill Book Co., 1987.
5. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company, 2008.

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1909719 TESTING OF MATERIALS L T P C

3 0 0 3

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Apply the concept of testing to various materials and result analysis.
- Apply various mechanical testing procedures to different materials.
- Apply different non destructive testing procedures to different materials.
- Apply material characterization testing for analysis.
- Apply advanced testing techniques for thermal and chemical fields.

UNIT-I: INTRODUCTION TO MATERIALS TESTING 9

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing

UNIT-II: MECHANICAL TESTING **9**

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT-III: NON DESTRUCTIVE TESTING **9**

Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT-IV: MATERIAL CHARACTERIZATION TESTING **9**

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT-V: OTHER TESTING **9**

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Apply the concept of testing to various materials and result analysis.

- Apply various mechanical testing procedures to different materials.
- Apply different non destructive testing procedures to different materials.
- Apply material characterization testing for analysis.
- Apply advanced testing techniques for thermal and chemical fields.

TEXTBOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Cullity, B. D., “Elements of X-ray diffraction”, 3rd Edition, Addison-Wesley Company Inc., New York, 2000.

REFERENCE BOOKS:

1. P. Field Foster, “The Mechanical Testing of Metals and Alloys” 7th Edition, Cousens Press, 2007.
2. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
3. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA.
4. Brandon D.G., “Modern Techniques in Metallography”, Von Nostrand Inc. NJ, USA, 1986.

CO	PO												PSO			
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1909720 DESIGN OF ELECTRIC VEHICLES L T P C

3 0 0 3

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understand about electric vehicle technology.
- Understand the load distribution and stability of vehicles.
- Analyze the handling characteristics of road vehicles.
- Analyze the steering, suspension and designing of breaks.
- Understand hybrid vehicles, power electronics and fuel cell vehicles.

UNIT-I: INTRODUCTION TO ELECTRIC VEHICLES 9

Electric Vehicle – Need - Types – Cost and Emissions – End of life. Electric Vehicle Technology – layouts, cables, components, Controls. Batteries – overview and its types. Battery plug-in and life. Ultra-capacitor, Charging – Methods and Standards. Alternate charging sources – Wireless & Solar.

UNIT-II: STABILITY OF VEHICLES 9

Load distribution for three wheeler and four wheeler-Stability of vehicle running on slope, banked road and during turn-calculation of Tractive effort, maximum acceleration and reaction forces for different drives.

UNIT-III: HANDLING CHARACTERISTICS OF ROAD VEHICLES 9

Steering geometry-Steady state handling characteristics- Steady state response to steering input-Testing of handling characteristics-Transient response characteristics-Directional stability.

UNIT-IV: STEERING, SUSPENSION AND BRAKE 9

Steering System - Ackerman Principle of Steering - Front End Geometry - Steering Gearbox- Types- Recirculating Ball - Rack and Pinion - Power Steering. Suspension - Front and Rear Forks - Springs for Suspension - Telescopic Suspension - Monoshock

Suspension - Hydraulic Shock Absorber - Dampers. Design Consideration – Brake - Drum Brakes - Disc Brakes - ABS

UNIT-V: POWER ELECTRONICS AND CONTROL FOR HYBRID AND FUEL CELL VEHICLES **9**

Series Hybrid Vehicle Propulsion System, Parallel Hybrid Vehicle Propulsion System, Fuel Cell Vehicles, Power Electronics Requirements, Propulsion Motor Control Strategies, APU Control System in Series Hybrid Vehicles, Fuel Cell for APU Applications.

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Understand about electric vehicle technology.
- Understand the load distribution and stability of vehicles.
- Analyze the handling characteristics of road vehicles.
- Analyze the steering, suspension and designing of breaks.
- Understand hybrid vehicles, power electronics and fuel cell vehicles.

TEXTBOOKS:

1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
2. Rajesh Rajamani, "Vehicle Dynamics and Control", 1st edition, Springer, 2005

REFERENCE BOOKS:

1. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", Society of Automotive Engineers Inc, 1992.
2. Dr.Kirpal Singh, ‘Automobile Engineering’- Vol. I and II, Standard Publishers, New Delhi, 2011

3. V. Ganesan, 'Internal Combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2010.
4. Ali Emadi, "Handbook of Automotive Power Electronics and Drives", Taylor & Francis Group, First Edition, USA, 2005.

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1920701 ANALYTICAL METHODS AND INSTRUMENTATION L T P C

3 0 0 3

OBJECTIVES

- Make the students understand the basics of spectrometry
- To explore the knowledge on molecular spectroscopy.
- To introduce the NMR and MASS spectrometry.
- To elucidate the various separation methods in chromatography.
- To gain knowledge on potentiometry and surface microscope.

UNIT- I: SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments– Sources of radiation – wavelength selectors – sample containers –

radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Applications.

UNIT –II: MOLECULAR SPECTROSCOPY **9**

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence –Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT- III: NMR AND MASS SPECTROMETRY **9**

Theory of NMR – chemical shift- NMR-spectrometers – applications of 1H and 13C NMR-Molecular mass spectra – ion sources.Mass spectrometer.Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation.

UNIT- IV: SEPARATION METHODS **9**

General description of chromatography – Band broadening and optimization of column performance-Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography-Affinity chromatography- principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT-V: ELECTRO ANALYSIS AND SURFACE MICROSCOPY **9**

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand the concept of spectrometry

- Ability to know the operations of various instruments.
- Able to apply molecular spectroscopy concepts in NMR and MASS spectrometry.
- Ability to understand surface microscopy and its applications.

TEXT BOOKS:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch “Instrumental Methods of Analysis”.CengageLearning , 2007.
2. Willard, Hobart, etal., “Instrumental Methods of Analysis”. VIIth Edition, CBS, 1986.
3. Braun, Robert D. “Introduction to Instrumental Analysis”. Pharma Book Syndicate, 1987.
4. Ewing,G.W. “Instrumental Methods of Chemical Analysis”, Vth Edition, McGraw-Hill, 1985

REFERENCE BOOKS:

1. Sharma, B.K. “Instrumental Methods of Chemical Analysis : Analytical Chemistry” GoelPublishing House, 1972.
2. Haven, Mary C., etal., “Laboratory Instrumentation “. IVth Edition, John Wiley, 1995.

CO	PO												PSO			
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2	2	2	3	2	2	-	-	2	2	3	2	1	-	-	2	-
3	2	2	3	3	3	-	2	2	2	3	3	1	-	-	2	-
4	3	2	3	3	3	-	-	3	2	3	3	1	-	-	2	-
5	3	-	3	2	2	-	-	3	-	3	2	1	-	-	2	-

1920702 MEDICAL PHYSICS L T P C
3 0 0 3

OBJECTIVES

- To study the complete non-ionizing radiations including light and its effect in human body.
- To understand the principles of ultrasound radiation and its applications in medicine.
- To learn about radioactive nuclides.
- To know the interactions of radiation with matters and how isotopes are produced.
- To study the harmful effects of radiation and radiation protection regulations.

UNIT-I: NON-IONIZING RADIATION AND ITSMEDICALAPPLICATION 9

Introduction to EM waves - Tissue as a leaky dielectric - Relaxation processes: Debye model, Cole–Cole model- Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light-Measurement of light and its unit- limits of vision and color vision an overview - Applications of ultraviolet in medicine, Thermography.

UNIT-II: ULTRASOUND IN MEDICINE 9

Ultrasound fundamentals – Generation of ultrasound (Ultrasound Transducer) - Interaction of Ultrasound with matter: Cavitation, Reflection, Transmission- Scanning systems – Artefacts- Ultrasound- Doppler-Double Doppler shift-Clinical Applications-Ultrasonography.

UNIT-III: PRINCIPLES OF RADIOACTIVE NUCLIDES AND DECAY 9

Introduction to Radioisotopes - Radioactive decay : Spontaneous Fission, Isomeric Transition, Alpha Decay, Beta Decay, Positron Decay, Electron Capture- Radioactive decay equations – Half life- Mean Life- Effective half-life - Natural and Artificial radioactivity, - Production of radionuclide – Cyclotron produced Radionuclide - Reactor produced Radionuclide: fission and electron Capture reaction, Target and Its

Processing Equation for Production of Radionuclide - Radionuclide Generator- Technetium generator.

UNIT-IV: INTERACTION OF RADIATIONWITH MATTER 9

Interaction of charged particles with matter –Specific ionization, Linear energy transfer, range, Bremsstrahlung, Annihilation - Interaction of X and Gamma radiation with matter: Photoelectric effect, Compton Scattering, Pair production- Attenuation of Gamma Radiation - Interaction of neutron with matter and their clinical significance- Radionuclide used in Medicine and Technology.

UNIT-V: RADIATION EFFECTSAND REGULATIONS 9

Classification of Radiation Damage, Stochastic and Deterministic Effects, Acute Effects of Total Body Irradiation, Long-Term Effects of Radiation, Risk Versus Benefit in Diagnostic Radiology and Nuclear Medicine, Risk of Pregnant Women, Nuclear Regulatory Commission, ALARA Program, Medical Uses of Radioactive Materials, Survey for Contamination and Exposure Rate, Dose Calibrators and Survey Meters, Bioassay, Radioactive Waste Disposal.

TOTAL: 45 PERIODS

OUTCOMES

- Analyze the low frequency and high frequency effects of non-ionizing radiation and physics of light.
- Define various clinical applications based on ultra soundwave.
- Explain the process of radioactive nuclide production using different techniques
- Analyze radiation mechanics involved with various physiological systems
- Outline the detrimental effects of radiation and regulations for radiation safety.

TEXT BOOKS:

1. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, Medical Physics and Biomedical Engineering, 2nd Edition, IOP Publishers.2001. (Unit I &II)

2. Gopal B. Saha, Physics and Radiobiology of Nuclear Medicine, 4th Edition, Springer, 2013. (Unit III &IV)
3. R.Hendee and Russell Ritenour “Medical Imaging Physics”, Fourth Edition William, Wiley-Liss, 2002. (Unit V).

REFERENCE BOOKS:

1. S.Webb “ The Physics of Medical Imaging”, Taylor and Francis,1988
2. HyltonB.Meire and Pat Farrant “Basic Ultrasound” John Wiley & Sons,1995
3. John R Cameran , James G Skofronick “Medical Physics” John-Wiley & Sons.1978.

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

1920703 ELECTRONIC MATERIALS L T P C

3 0 0 3

OBJECTIVES

- To Understand the various materials and its properties towards electrical and electronics field.
- To cover the properties of conducting materials.
- Make the students to understand various semiconducting and magnetic materials and their properties.
- To give an idea on dielectric and insulating materials.
- To explore the knowledge on optoelectronic and nano materials.

UNIT- I: INTRODUCTION 7

Structure: atomic structures and bonding, types of bonding, band formation.Defects and imperfections in solids: Point, Line and Planar defects; Interfacial defects and volume defects.Classification of materials based on bonding: conductors, semiconductors and insulators.

UNIT- II: CONDUCTING MATERIALS **9**

Introduction, factors affecting the conductivity of materials, classification based on conductivity of materials, temperature dependence of resistivity, Low resistivity materials (graphite, Al, Cu and steel) and its applications, high resistivity materials (manganin, constantan, nichrome, tungsten) and their applications. Superconductors: Meissner effect, classification and applications.

UNIT- III: SEMICONDUCTING AND MAGNETIC MATERIALS **10**

Semiconductors: Introduction, types of semiconductors, temperature dependence of semiconductors, compound semiconductors, basic ideas of amorphous and organic semiconductors. Magnetic Materials: classification of magnetic materials, ferromagnetism-B-H curve (Qualitative), hard and soft magnetic materials, magneto materials applications.

UNIT- IV: DIELECTRIC AND INSULATING MATERIALS **9**

Dielectric Materials: Introduction, classification, temperature dependence on polarization, properties,dielectric loss, factors influencing dielectric strength and capacitor materials, applications. Insulators: Introduction, thermal and mechanical properties required for insulators, Inorganic materials, organic materials, liquid insulators, gaseous insulators and ageing of insulators, applications.

UNIT –V: OPTOELECTRONIC ANDNANO ELECTRONIC MATERIALS **10**

Optoelectronic materials. Introduction, properties, factor affecting optical properties, role of optoelectronic materials in LEDs, LASERs, photo detectors, solar cells. Nano electronic Materials: Introduction, advantage of nanoelectronic devices, materials, fabrication, challenges in Nano electronic materials.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand the fundamentals of conducting materials
- Able to define various applications of semiconducting and magnetic materials
- Able to explain the concepts of dielectrics and insulating materials
- Ability to explain various optoelectronic devices and nano electronic materials
- With the basis, students will be able to have clear concepts on electronic behaviors of materials.

TEXT BOOKS:

1. S.O. Kasap “Principles of Electronic Materials and Devices”, 3rd edition, McGraw-Hill Education (India) Pvt. Ltd., 2007.
2. W D Callister, “Materials Science & Engineering – An Introduction”, Jr., John Willey &Sons,Inc, New York, 7th edition, 2007.

REFERENCE BOOKS:

1. B.G. Streetman and S. Banerjee, Solid State Electronic Devices, 6th edition, PHI Learning, 2009.
2. Eugene A. Irene, Electronic Materials Science, Wiley, 2005
3. Wei Gao, Zhengwei Li, Nigel Sammes, An Introduction to Electronic Materials for Engineers, 2nd Edition, World Scientific Publishing Co. Pvt. Ltd., 2011.

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