ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS AFFILIATED COLLEGES
REGULATIONS 2021

B. TECH. AGRICULTURAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. To train and educate students with general knowledge and skills in agricultural water management, agricultural production process, farm machinery and farm management.
II. To provide a sound theoretical knowledge in engineering principles applied to agriculture.
III. To prepare students for a successful agricultural engineering career integrating all aspects of engineering in agriculture.
IV. To develop innovative capacity of students for increasing agricultural production with scarce water resources available.
V. To impart positive and responsive out their mission as engineers. reach attitudes, initiative and creative thinking in their mission as engineers.
VI. To understand ethical issues and responsibility of serving the society and the environment at large.

PROGRAM OUTCOMES (POs)

Graduates of the programme B.Tech. Agricultural Engineering will be able to:

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, review 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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates of the programme B.Tech. Agricultural Engineering will be able to

1. To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill.

2. To enhance the ability of the students to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.

3. To inculcate entrepreneurial skills through strong Industry-Institution linkage.

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NON-AUTONOMOUS AFFILIATED COLLEGES
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
B. TECH. AGRICULTURAL ENGINEERING
CURRICULUM FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS III AND IV

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP3151	Induction Programme	-	-	-	-	-	0
THEORY								
2.	HS3151	Professional English - I	HSMC	3	0	0	3	3
3.	MA3151	Matrices and Calculus	BSC	3	1	0	4	4
4.	PH3151	Engineering Physics	BSC	3	0	0	3	3
5.	CY3151	Engineering Chemistry	BSC	3	0	0	3	3
6.	GE3151	Problem Solving and Python Programming	ESC	3	0	0	3	3
7.	GE3152	**அறிவியல் தமிழ் /Scientific Thoughts in Tamil**	HSMC	1	0	0	1	1
PRACTICALS								
8.	GE3171	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
9.	BS3171	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
10.	GE3172	English Laboratory[$]	EEC	0	0	2	2	1
			TOTAL	**16**	**1**	**10**	**27**	**22**

[$] Skill Based Course

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIOD PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS3251	Professional English - II	HSMC	2	0	0	2	2
2.	MA3251	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	AI3201	Principles and Practices of Crop Production	PCC	2	0	2	4	3
4.	BE3252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	0	0	3	3
5.	GE3251	Engineering Graphics	ESC	2	0	4	6	4
6.		NCC Credit Course Level 1[#]	-	2	0	0	2	2[#]
7.	GE3252	**தமிழர் மரபு /Heritage of Tamils**	HSMC	1	0	0	1	1
PRACTICALS								
8.	GE3271	Engineering Practices Laboratory	ESC	0	0	4	4	2
9.	BE3272	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	0	0	4	4	2
10.	GE3272	Communication Laboratory / Foreign Language [$]	EEC	0	0	4	4	2
			TOTAL	**13**	**1**	**18**	**32**	**23**

[#] NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA
[$] Skill Based Course

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3301	Fourier Series and Linear Programming	BSC	3	1	0	4	4
2.	AI3301	Principles of Soil Science and Engineering	PCC	3	0	0	3	3
3.	AI3302	Unit Operations in Agricultural Processing	PCC	2	0	2	4	3
4.	AI3303	Fluid Mechanics and Pumps	PCC	3	0	0	3	3
5.	ME3491	Theory of Machines	PCC	3	0	0	3	3
6.	CE3351	Surveying and Levelling	PCC	3	0	0	3	3
PRACTICALS								
7.	AI3311	Fluid Mechanics Laboratory	PCC	0	0	4	4	2
8.	AI3312	Soil Science Laboratory	PCC	0	0	3	3	1.5
9.	CE3361	Surveying and Levelling Laboratory	PCC	0	0	3	3	1.5
10.	GE3361	Professional Development [$]	EEC	0	0	2	2	1
			TOTAL	**17**	**1**	**14**	**32**	**25**

[$] Skill Based Course

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AI3401	Tractors and Engine Systems	PCC	3	0	0	3	3
2.	AI3402	Soil and Water Conservation Engineering	PCC	3	0	0	3	3
3.	AI3403	Strength of Materials for Agricultural Engineering	PCC	3	0	0	3	3
4.	CE3691	Hydrology and Water Resources Engineering	PCC	3	0	0	3	3
5.	ME3391	Engineering Thermodynamics	ESC	3	0	0	3	3
6.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit Course Level 2[#]		3	0	0	3	3[#]
PRACTICALS								
8.	AI3411	Tractors and Farm Engines Laboratory	PCC	0	0	2	2	1
9.	AI3412	Strength of Materials Laboratory	PCC	0	0	4	4	2
			TOTAL	**17**	**0**	**6**	**23**	**20**

[#] NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AI3501	Farm Equipment and Machinery	PCC	3	0	0	3	3
2.		Professional Elective I	PEC	3	0	0	3	3
3.		Professional Elective II	PEC	3	0	0	3	3
4.		Professional Elective III	PEC	3	0	0	3	3
5.		Professional Elective IV	PEC	3	0	0	3	3
6.		Mandatory Course-I[&]	MC	3	0	0	3	0
PRACTICALS								
7.	AI3511	Farm Machinery Laboratory	PCC	0	0	4	4	2
8.	AI3512	ICT in Agricultural Engineering Laboratory	PCC	0	0	4	4	2
9.	AI3513	Summer Training (2 weeks)**	EEC	0	0	0	0	1
			TOTAL	**18**	**0**	**8**	**26**	**20**

[&] Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC-I)
**** Summer training has to be completed during the summer vacation, after the completion of Semester IV.**

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AI3601	Post-Harvest Technology	PCC	3	0	0	3	3
2.	AI3602	Irrigation and Drainage Engineering	PCC	3	0	0	3	3
3.		Professional Elective V	PEC	3	0	0	3	3
4.		Professional Elective VI	PEC	3	0	0	3	3
5.		Professional Elective VII	PEC	3	0	0	3	3
6.		Open Elective – I*	OEC	3	0	0	3	3
7.		Mandatory Course-II[&]	MC	3	0	0	3	0
8.		NCC Credit Course Level 3[#]		3	0	0	3	3 [#]
PRACTICALS								
9.	AI3611	CAD for Agriculture Machinery Laboratory	PCC	0	0	4	4	2
10.	AI3612	Post – Harvest Technology Laboratory	PCC	0	0	2	2	1
11.	AI3613	Irrigation Field Laboratory	PCC	0	0	2	2	1
			TOTAL	**21**	**0**	**8**	**29**	**22**

***Open Elective – I shall be chosen from the emerging technologies**

[&] Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC-II)

[#] NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

SEMESTER VII/VIII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AI3701	Remote Sensing and Geographical Information System	PCC	3	0	0	3	3
2.	AI3702	Renewable Energy in Agricultural Engineering	PCC	3	0	0	3	3
3.	GE3791	Human Values and Ethics	HSMC	2	0	0	2	2
4.	GE3752	Total Quality Management	HSMC	3	0	0	3	3
5.		Open Elective – II**	OEC	3	0	0	3	3
6.		Open Elective – III***	OEC	3	0	0	3	3
7.		Open Elective – IV***	OEC	3	0	0	3	3
PRACTICALS								
8.	AI3711	Remote Sensing and GIS Laboratory	PCC	0	0	4	4	2
9.	AI3712	Renewable Energy in Agricultural Engineering Laboratory	PCC	0	0	2	2	1
			TOTAL	**20**	**0**	**6**	**26**	**23**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VII**
****Open Elective – II shall be chosen from the emerging technologies**
*****Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes**

SEMESTER VIII/VII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	Ai3811	Project Work/Internship	EEC	0	0	20	20	10
			TOTAL	**0**	**0**	**20**	**20**	**10**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII**

TOTAL CREDITS: 165

MANDATORY COURSES I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3081	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2.	MX3082	Elements of Literature	MC	3	0	0	3	0
3.	MX3083	Film Appreciation	MC	3	0	0	3	0
4.	MX3084	Disaster Management	MC	3	0	0	3	0

MANDATORY COURSES II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3085	Well Being with Traditional Practices (Yoga, Ayurveda and Siddha)	MC	3	0	0	3	0
2.	MX3086	History of Science and Technology in India	MC	3	0	0	3	0
3.	MX3087	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4.	MX3088	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	MX3089	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL I Food Processing	VERTICAL II Farm Machinery and Energy	VERTICAL III Water Management and Protected cultivation	VERTICAL IV IT and Agricultural Business management
.Refrigeration and cold Storage	Farm Power and Machinery Management	Watershed planning and Management	Integrated Farming System
Food and Dairy Engineering	Testing and Evaluation of farm Machinery and equipment	Groundwater and Well Engineering	Agri Business Management
Process Engineering of Fruits and Vegetables	Biochemical and Thermochemical conversion of biomass	Design of Micro-irrigation system	Sustainable Agriculture and Food Security
Storage and Packaging Technology	Waste and by product utilization	Protected Cultivation	Systems Analysis in Agricultural Engineering
Food Process Equipment and Design	Human Engineering and Safety in Farm Machinery Operations	On-farm water management	IT in Agricultural System
Food Plant Design and Management	Precision Farming Equipment	Irrigation Water Quality and Waste Water Management	Automation in Agriculture
Emerging Technologies in Food Processing	Solar and Wind energy system	Climate change and Adaptation	Landscape architecture

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2021, Clause 4.10.

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL I: FOOD PROCESSING

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AI3001	Refrigeration and Cold Storage	PEC	3	0	0	3	3
2.	AI3002	Food and Dairy Engineering	PEC	3	0	0	3	3
3.	AI3003	Process Engineering of Fruits and Vegetables	PEC	3	0	0	3	3
4.	AI3004	Storage and Packaging Technology	PEC	3	0	0	3	3
5.	AI3005	Food Process Equipment and Design	PEC	3	0	0	3	3
6.	AI3006	Food Plant Design and Management	PEC	3	0	0	3	3
7.	AI3007	Emerging Technologies in Food Processing	PEC	3	0	0	3	3

VERTICAL II: FARM MACHINERY AND ENERGY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AI3008	Farm Power and Machinery Management	PEC	3	0	0	3	3
2.	AI3009	Testing and Evaluation of Farm Machinery and Equipment	PEC	3	0	0	3	3
3.	CAI331	Biochemical and Thermochemical Conversion of Biomass	PEC	3	0	0	3	3
4.	AI3010	Waste and By Product Utilization	PEC	3	0	0	3	3
5.	AI3011	Human Engineering and Safety in Farm Machinery Operations	PEC	3	0	0	3	3
6.	AI3012	Precision Farming Equipment	PEC	3	0	0	3	3
7.	CAI335	Solar and Wind Energy System	PEC	3	0	0	3	3

VERTICAL III: WATER MANAGEMENT AND PROTECTED CULTIVATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AI3013	Watershed Planning and Management	PEC	3	0	0	3	3
2.	CAI333	Groundwater and Well Engineering	PEC	3	0	0	3	3
3.	AI3014	Design of Micro-Irrigation System	PEC	3	0	0	3	3
4.	AI3015	Protected Cultivation	PEC	3	0	0	3	3
5.	AI3016	On-farm Water Management	PEC	3	0	0	3	3
6.	CAI334	Irrigation Water Quality and Waste Water Management	PEC	3	0	0	3	3
7.	CAI332	Climate Change and Adaptation	PEC	3	0	0	3	3

VERTICAL IV: IT AND AGRICULTURAL BUSINESS MANAGEMENT

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	AI3017	Integrated Farming System	PEC	3	0	0	3	3
2.	AI3018	Agricultural Business Management	PEC	3	0	0	3	3
3.	AI3019	Sustainable Agriculture and Food Security	PEC	3	0	0	3	3
4.	AI3020	Systems Analysis in Agricultural Engineering	PEC	3	0	0	3	3
5.	AI3021	IT in Agricultural System	PEC	3	0	0	3	3
6.	AI3022	Automation in Agriculture	PEC	3	0	0	3	3
7.	AI3023	Landscape Architecture	PEC	3	0	0	3	3

OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories)

OPEN ELECTIVE I AND II
(EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OCS351	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2.	OCS352	IoT Concepts and Applications	OEC	2	0	2	4	3
3.	OCS353	Data Science Fundamentals	OEC	2	0	2	4	3
4.	OCS354	Augmented and Virtual Reality	OEC	2	0	2	4	3

OPEN ELECTIVES – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS351	English for Competitive Examinations	OEC	3	0	0	3	3
2.	OMG352	NGOs and Sustainable Development	OEC	3	0	0	3	3
3.	OMG353	Democracy and Good Governance	OEC	3	0	0	3	3
4.	OME353	Renewable Energy Technologies	OEC	3	0	0	3	3
5.	OME354	Applied Design Thinking	OEC	2	0	2	4	3
6.	OMF351	Reverse Engineering	OEC	3	0	0	3	3
7.	OMF353	Sustainable Manufacturing	OEC	3	0	0	3	3
8.	OAU351	Electric and Hybrid Vehicle	OEC	3	0	0	3	3
9.	OAS352	Space Engineering	OEC	3	0	0	3	3
10.	OIM351	Industrial Management	OEC	3	0	0	3	3
11.	OIE354	Quality Engineering	OEC	3	0	0	3	3
12.	OSF351	Fire Safety Engineering	OEC	3	0	0	3	3
13.	OML351	Introduction to non-destructive testing	OEC	3	0	0	3	3
14.	OMR351	Mechatronics	OEC	3	0	0	3	3
15.	ORA351	Foundation of Robotics	OEC	3	0	0	3	3
16.	OAE352	Fundamentals of Aeronautical engineering	OEC	3	0	0	3	3
17.	OGI351	Remote Sensing Concepts	OEC	3	0	0	3	3
18.	OCE353	Lean Concepts, Tools And Practices	OEC	3	0	0	3	3
19.	OEN351	Drinking Water Supply and Treatment	OEC	3	0	0	3	3

20.	OEE352	Electric Vehicle technology	OEC	3	0	0	3	3
21.	OEI353	Introduction to PLC Programming	OEC	3	0	0	3	3
22.	OCH351	Nano Technology	OEC	3	0	0	3	3
23.	OCH352	Functional Materials	OEC	3	0	0	3	3
24.	OBT352	Biomedical Instrumentation	OEC	3	0	0	3	3
25.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3
26.	OFD353	Introduction to food processing	OEC	3	0	0	3	3
27.	OPY352	IPR for Pharma Industry	OEC	3	0	0	3	3
28.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
29.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
30.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3
31.	OPE351	Introduction to Petroleum Refining and Petrochemicals	OEC	3	0	0	3	3
32.	OPE352	Energy Conservation and Management	OEC	3	0	0	3	3
33.	OPT351	Basics of Plastics Processing	OEC	3	0	0	3	3
34.	OEC351	Signals and Systems	OEC	3	0	0	3	3
35.	OEC352	Fundamentals of Electronic Devices and Circuits	OEC	3	0	0	3	3
36.	OBM351	Foundation Skills in integrated product Development	OEC	3	0	0	3	3
37.	OBM352	Assistive Technology	OEC	3	0	0	3	3
38.	OMA352	Operations Research	OEC	3	0	0	3	3
39.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
40.	OMA354	Linear Algebra	OEC	3	0	0	3	3

OPEN ELECTIVES – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS352	Project Report Writing	OEC	3	0	0	3	3
2.	OMA355	Advanced Numerical Methods	OEC	3	0	0	3	3
3.	OMA356	Random Processes	OEC	3	0	0	3	3
4.	OMA357	Queuing and Reliability Modelling	OEC	3	0	0	3	3
5.	OMG354	Production and Operations Management for Entrepreneurs	OEC	3	0	0	3	3
6.	OMG355	Multivariate Data Analysis	OEC	3	0	0	3	3
7.	OME352	Additive Manufacturing	OEC	3	0	0	3	3

8.	OME353	New Product Development	OEC	3	0	0	3	3
9.	OME355	Industrial Design & Rapid Prototyping Techniques	OEC	2	0	2	4	3
10.	OMF352	Micro and Precision Engineering	OEC	3	0	0	3	3
11.	OMF354	Cost Management of Engineering Projects	OEC	3	0	0	3	3
12.	OAU352	Batteries and Management system	OEC	3	0	0	3	3
13.	OAU353	Sensors and Actuators	OEC	3	0	0	3	3
14.	OAS353	Space Vehicles	OEC	3	0	0	3	3
15.	OIM352	Management Science	OEC	3	0	0	3	3
16.	OIM353	Production Planning and Control	OEC	3	0	0	3	3
17.	OIE353	Operations Management	OEC	3	0	0	3	3
18.	OSF352	Industrial Hygiene	OEC	3	0	0	3	3
19.	OSF353	Chemical Process Safety	OEC	3	0	0	3	3
20.	OML352	Electrical, Electronic and Magnetic materials	OEC	3	0	0	3	3
21.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
22.	OMR352	Hydraulics and Pneumatics	OEC	3	0	0	3	3
23.	OMR353	Sensors	OEC	3	0	0	3	3
24.	ORA352	Foundation of Automation	OEC	3	0	0	3	3
25.	ORA353	Concepts in Mobile Robotics	OEC	3	0	0	3	3
26.	OMV351	Marine Propulsion	OEC	3	0	0	3	3
27.	OMV352	Marine Merchant Vehicles	OEC	3	0	0	3	3
28.	OMV353	Elements of Marine Engineering	OEC	3	0	0	3	3
29.	OAE353	Drone Technologies	OEC	3	0	0	3	3
30.	OGI352	Geographical Information System	OEC	3	0	0	3	3
31.	OCE354	Basics of Integrated Water Resources Management	OEC	3	0	0	3	3
32.	OEN352	Biodiversity Conservation	OEC	3	0	0	3	3
33.	OEE353	Introduction to control systems	OEC	3	0	0	3	3
34.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
35.	OCH353	Energy Technology	OEC	3	0	0	3	3
36.	OCH354	Surface Science	OEC	3	0	0	3	3
37.	OBT353	Environment and Agriculture	OEC	3	0	0	3	3

38.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
39.	OFD355	Food safety and Quality Regulations	OEC	3	0	0	3	3
40.	OPY353	Nutraceuticals	OEC	3	0	0	3	3
41.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
42.	OTT355	Fibre Science	OEC	3	0	0	3	3
43.	OTT356	Garment Manufacturing Technology	OEC	3	0	0	3	3
44.	OPE353	Industrial safety	OEC	3	0	0	3	3
45.	OPE354	Unit Operations in Petro Chemical Industries	OEC	3	0	0	3	3
46.	OPT352	Plastic Materials for Engineers	OEC	3	0	0	3	3
47.	OPT353	Properties and Testing of Plastics	OEC	3	0	0	3	3
48.	OEC353	VLSI Design	OEC	3	0	0	3	3
49.	OEC354	Industrial IoT and Industry 4.0	OEC	2	0	2	4	3
50.	OBM353	Wearable devices	OEC	3	0	0	3	3
51.	OBM354	Medical Informatics	OEC	3	0	0	3	3

SUMMARY

S.No.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII/VIII	VIII/VII	
1.	**HSMC**	4	3					5		**12**
2.	**BSC**	12	4	4	2					**22**
3.	**ESC**	5	11		3					**19**
4.	**PCC**		3	20	15	7	10	9		**64**
5.	**PEC**					12	9			**21**
6.	**OEC**						3	9		**12**
7.	**EEC**	1	2	1		1			10	**15**
	Total	**22**	**23**	**25**	**20**	**20**	**22**	**23**	**10**	**165**
8.	Mandatory Course (Non credit)					✓	✓			

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.

Complete details are available in clause 4.10 of Regulations 2021.

VERTICALS FOR MINOR DEGREE (In addition to all the verticals of other programmes)

VERTICAL I	VERTICAL II	VERTICAL III	VERTICAL IV	VERTICAL V
Fintech and Block Chain	**Entrepreneurship**	**Public Administration**	**Business Data Analytics**	**Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management for Business	Constitution of India	Datamining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurship	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
-	-	-	-	Integrated Energy Planning for Sustainable Development
-	-	-	-	Energy Efficiency for Sustainable Development

(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

VERTICAL 1: FINTECH AND BLOCK CHAIN

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG331	Financial Management	PEC	3	0	0	3	3
2.	CMG332	Fundamentals of Investment	PEC	3	0	0	3	3
3.	CMG333	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	CMG334	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5.	CMG335	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	CMG336	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL 2: ENTREPRENEURSHIP

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG337	Foundations of Entrepreneurship	PEC	3	0	0	3	3
2.	CMG338	Team Building and Leadership Management for Business	PEC	3	0	0	3	3
3.	CMG339	Creativity and Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	CMG340	Principles of Marketing Management for Business	PEC	3	0	0	3	3
5.	CMG341	Human Resource Management for Entrepreneurship	PEC	3	0	0	3	3
6.	CMG342	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL 3: PUBLIC ADMINISTRATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG343	Principles of Public Administration	PEC	3	0	0	3	3
2.	CMG344	Constitution of India	PEC	3	0	0	3	3
3.	CMG345	Public Personnel Administration	PEC	3	0	0	3	3
4.	CMG346	Administrative Theories	PEC	3	0	0	3	3
5.	CMG347	Indian Administrative System	PEC	3	0	0	3	3
6.	CMG348	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL 4: BUSINESS DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG349	Statistics for Management	PEC	3	0	0	3	3
2.	CMG350	Datamining for Business Intelligence	PEC	3	0	0	3	3
3.	CMG351	Human Resource Analytics	PEC	3	0	0	3	3
4.	CMG352	Marketing and Social Media Web Analytics	PEC	3	0	0	3	3
5.	CMG353	Operation and Supply Chain Analytics	PEC	3	0	0	3	3
6.	CMG354	Financial Analytics	PEC	3	0	0	3	3

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

SL. NO	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CES331	Sustainable infrastructure Development	PEC	3	0	0	3	3
2.	CES332	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	CES333	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	CES334	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	CES335	Green Technology	PEC	3	0	0	3	3
6.	CES336	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7.	CES337	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8.	CES338	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3

MA3301 FOURIER SERIES AND LINEAR PROGRAMMING 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 series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To have knowledge in solving linear programming problems.
- To acquaint knowledge to solve transportation and assignment problems.
- To familiar with the method of solving nonlinear programming problems.

UNIT I FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value - Parseval's identity— Harmonic analysis.

UNIT II FOURIER TRANSFORMS 9+3

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

UNIT III LINEAR PROGRAMMING PROBLEMS 9+3

Mathematical formulation - Graphical method - Simplex method - Artificial variable techniques - Big M Method - Two phase Simplex method - Duality - Dual Simplex method.

UNIT IV TRANSPORTATION AND ASSIGNMENT PROBLEMS 9+3

Matrix form - Loops in T.P - Initial basic feasible solutions - Transportation algorithm - Degeneracy in T.P - Assignment and Routing problems.

UNIT V NON-LINEAR PROGRAMMING PROBLEMS 9+3

Lagrange multipliers – Equality constraints – Inequality constraints – Kuhn – Tucker Conditions – Quadratic programming.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2. H.A. Taha, "Operations Research - An introduction", 10th Edition, Pearson Education, New Delhi, 2017.
3. Kanti Swarup, Guptha P.K. and Man Mohan, "Operations Research", 5th Edition, Sultan Chand & Sons, New Delhi, 2010.

REFERENCES:

1. Kreyszig E, "Advanced Engineering Mathematics", 10th Edition, John Wiley, New Delhi, India, 2016.
2. Ravindran, Philips and Solberg "Operations Research, Principles and Practice", 2nd Edition, Wiley, , New Delhi, 2007.
3. Frederick S Hillier and Gerald J. Lieberman**, "**Introduction to Operations Research", Mc Graw Hill, New Delhi, 2017.
4. J.K.Sharma , " Operations Research - Theory and Applications ", Mac Millan India Ltd , 2nd Edition , New Delhi , 2003.
5. Richard Bronson & Govindasami Naadimuthu, "Operations Research" (Schaum's Outlines – TMH Edition) Tata McGraw Hill, 2nd Edition, New Delhi, 2004.

COURSE OUTCOMES:

1. Apply Fourier series techniques used in wide variety of situations in which the functions used are not periodic and to solve boundary value problems.
2. Apply the Fourier transform techniques to solve boundary value problems.
3. Develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the Simplex method for solving linear programming problems.
4. Analyze the concept of developing , formulating , modeling and solving transportation and assignment problems.
5. Determine the optimum solution for non-linear programming problems.

AI3301 PRINCIPLES OF SOIL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

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

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.

UNIT V BEARING CAPACITY AND SLOPE STABILITY 9

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

TOTAL: 45 PERIODS

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.

REFERENCES:

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.

COURSE OUTCOMES:

On completion of the course, the student is expected to

1. Understand the fundamental knowledge of soil physical parameters.
2. Perform soil survey and classify soil based on its characteristics
3. Explain the phase relationship and soil compaction.
4. Analyze Engineering properties of soil
5. Understand Concepts of bearing capacity and slope stability.

AI3302 UNIT OPERATIONS IN AGRICULTURAL PROCESSING L T P C
2 0 2 3

OBJECTIVES:

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

UNIT I EVAPORATION AND CONCENTRATION 6

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 6

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 6

Size reduction – grinding and cutting – principles of comminuting – characteristics of comminuted products – particle size distribution in comminuted products-energy and power requirements in comminuting – crushing efficiency – Rittinger’s, Bond’s and Kick’s laws for crushing-size reduction equipment – crushers – jaw crusher, gyratory crusher-crushing rolls – grinders – hammer mills – rolling compression mills - attrition, rod, ball and tube mills – construction and operation.

UNIT IV CONTACT EQUILIBRIUM SEPARATION 6

Contact equilibrium separation processes – concentrations – gas-liquid and solid-liquid equilibrium – equilibrium concentration relationships – operating conditions-calculation of separation in contact – equilibrium processes-gas absorption – rate of gas absorption – stage – equilibrium gas – absorption equipment-properties of tower packing – types – construction – flow through packed towers-extraction – rate of extraction – stage equilibrium extraction-equipment for leaching coarse solids – intermediate solids – basket extractor-extraction of fine material – Dorr agitator – continuous leaching – decantation systems – extraction towers-washing – equipment

UNIT V CRYSTALLISATION AND DISTILLATION 6

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 equipment-Construction and operation-Factors influencing the operation.

TOTAL : 30 PERIODS

PRACTICAL

1. Determination of thermal efficiency and economy of evaporator
2. Determination of separation efficiency of centrifugal separator
3. Determination of collection efficiency in cyclone separator
4. Determination of efficiency of liquid-solid separation by filtration
5. Determination of absorption efficiency in a packing tower
6. Performance evaluation of a sieve and determination of particle size of granular foods by sieve analysis
7. Determination of energy requirement in size reduction using the burr mill
8. Determination of energy requirement in size reduction using the ball mill and hammer mill
9. Determination of mixing index for solids
10. Determination of economy and thermal efficiency of rotary flash evaporator for
11. Concentration of juice
12. Performance evaluation of a steam distillation process

TOTAL : 30 PERIODS

TEXT BOOKS:

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.

REFERENCES:

1. Coulson, J.M and J.F. Richardson. 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..

COURSE OUTCOMES:

On completion of the course, the student is expected to

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

AI3303 FLUID MECHANICS AND PUMPS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the students about the properties of the fluids, behaviour of fluids under static, kinematic and dynamic conditions through the control volume approach and expose them to the applications of the conservation laws and to impart basic knowledge of the dimensional analysis and model studies along with flow through pipes.

- The students will be exposed to the basic concepts of open channel flows with significance to steady uniform flows along with flow measurements in open channels.
- To expose the students to the classification of pumps the basic principles of working and to design centrifugal pump.

UNIT I FLUID PROPERTIES AND FLUID STATICS 9

Definition and properties of fluid - Mass density – Specific weight - Specific volume – Specific gravity - Equation of state – Perfect gas - Viscosity – Vapour pressure – Compressibility and elasticity - Surface tension – Capillarity- Fluid statics – Fluid pressure and measurement – simple, differential and micro manometers - Mechanical gauges - Forces on plane and curved surfaces - Buoyancy and floatation - Stability of floating bodies.

UNIT II FLUID KINEMATICS AND FLUID DYNAMICS 9

Classification of flows - Methods of analysis- Continuum hypothesis - System and Control volume approach - Streamline, streak-line and path-lines - Stream function - Velocity potentials - Flow nets - Application of control volume to continuity, energy and momentum - Euler's equation of motion along a stream line - Bernoulli's equation - Linear momentum equation – Applications.

UNIT III FLOW THROUGH PIPES AND MODEL STUDIES 9

Reynolds experiment - Laminar flow through circular pipe - Darcy-Weisbach equation - Moody diagram - Major and minor losses in pipe flow – Total energy line – Hydraulic grade line – Siphon - Pipes in series and parallel- Equivalent pipes- Fundamental dimensions - Dimensional homogeneity - Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV OPEN CHANNEL FLOWS 9

Types of flow – Characteristics of open channel - Chezy's equation - Manning equation – Hydraulically efficient channel sections - Critical depth – Specific energy application to channel transitions – Flow measurement in channels – Notches – Weirs - Parshall flume - Flow measurement in natural streams – float method – current meter.

UNIT V PUMPS 9

Types of pumps – Head of pump – Losses and efficiencies -Selection of pump capacity - Centrifugal pump – Components – Working principle – Types of impellers - Priming – NPSH - Cavitation – Minimum speed to start the pump - Specific speed – Characteristics curves - Turbine pump - Submersible pump - Jet pump – Air lift pump - Reciprocating pump - Sludge pump.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2017.
2. Modi P.N and Seth Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House, New Delhi, 2019.
3. Subramanya K., Flow in Open Channels, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2019.

REFERENCES:

1. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
2. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, McGraw Hill Education (India) Pvt. Ltd., 2017.
3. Chandramouli P N, Applied Hydraulic Engineering, Yes Dee Publisher, 2017
4. Ven Te Chow, Open Channel Hydraulics, McGraw Hill, New York, 2009.
5. Subramanya K, Fluid Mechanics and Hydraulic Machines: Problems and Solutions, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2018.

COURSE OUTCOMES:
On completion of the course, the student is expected to

- Demonstrate the properties of fluid and its behaviour in static conditions along with pressure measurements.
- Apply the conservation laws applicable to fluid flows and its application through fluid kinematics and dynamics.
- Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel and to understand the concept of application of dimensional analysis in model studies.
- Describe the basics characteristics of open channel flows and analysis of steady uniform flow with hydraulically efficient channel sections and to measure the flows in artificial/natural channels.
- Explain the classification, design and working principles of various pumps.

ME3491 THEORY OF MACHINES L T P C
3 0 0 3

OBJECTIVES:
- Applying the basic components of mechanisms, analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and design cam mechanisms for specified output motions.
- Applying the basic concepts of toothed gearing and kinematics of gear trains
- Analyzing the effects of friction in machine elements
- Analyzing the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms.
- Analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.

UNIT I KINEMATICS OF MECHANISMS 9
Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons– Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

UNIT II GEARS AND GEAR TRAINS 9
Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

UNIT III FRICTION IN MACHINE ELEMENTS 9
Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction aspects in brakes– Friction in vehicle propulsion and braking.

UNIT IV FORCE ANALYSIS 9
Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members

UNIT V BALANCING AND VIBRATION 9

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration isolation.(gyroscopic principles)

TOTAL 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to

- Discuss the basics of mechanism.
- Solve problems on gears and gear trains.
- Examine friction in machine elements.
- Calculate static and dynamic forces of mechanisms.
- Calculate the balancing masses and their locations of reciprocating and rotating masses. Computing the frequency of free vibration, forced vibration and damping coefficient.

TEXT BOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
2. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 2002.

REFERENCES:

1. AmitabhaGhosh and Asok Kumar Mallik, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., 1988.
2. Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2006.
3. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 2014.
4. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
5. Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.

CE3351 SURVEYING AND LEVELLING L T P C
3 0 0 3

OBJECTIVES:

- To introduce the rudiments of plane surveying and geodetic principles to Agricultural Engineers and to learn the various methods of plane and geodetic surveying to solve the real world problems. To introduce the concepts of Control Surveying. To introduce the basics of Astronomical Surveying

UNIT I FUNDAMENTALS OF CONVENTIONAL SURVEYING 9

Definition – Classifications – Basic principles – Equipment and accessories for ranging and chaining – Methods of ranging – Well conditioned triangles – Chain traversing – Compass – Basic principles – Types – Bearing – System and conversions – Sources of errors and Local attraction – Magnetic declination – Dip – compass traversing – Plane table and its accessories – Merits and demerits – Radiation – Intersection – Resection – Plane table traversing.

UNIT II LEVELLING 9

Level line – Horizontal line – Datum – Benchmarks – Levels and staves – Temporary and permanent adjustments – Methods of leveling – Fly leveling – Check leveling – Procedure in leveling – Booking – Reduction – Curvature and refraction – Reciprocal leveling – Precise leveling - Contouring.

UNIT III THEODOLITE SURVEYING 9

Horizontal and vertical angle measurements – Temporary and permanent adjustments – Heights and distances – Tacheometric surveying – Stadia Tacheometry – Tangential Tacheometry – Trigonometric leveling – Single Plane method – Double Plane method.

UNIT IV CONTROL SURVEYING AND ADJUSTMENT 9

Horizontal and vertical control – Methods – Triangulation – Traversing – Gale's table – Trilateration – Concepts of measurements and errors – Error propagation and Linearization – Adjustment methods - Least square methods – Angles, lengths and levelling network.

UNIT V MODERN SURVEYING 9

Total Station: Digital Theodolite, EDM, Electronic field book – Advantages – Parts and accessories – Working principle – Observables – Errors - COGO functions – Field procedure and applications. GPS: Advantages – System components – Signal structure – Selective availability and antispoofing receiver components and antenna – Planning and data acquisition – Data processing – Errors inGPS – Field procedure and applications.

TOTAL 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to

CO1 Introduce the rudiments of various surveying and its principles.
CO2 Imparts knowledge in computation of levels of terrain and ground features
CO3 Imparts concepts of Theodolite Surveying for complex surveying operations
CO4 Understand the procedure for establishing horizontal and vertical control
CO5 Imparts the knowledge on modern surveying instruments

TEXTBOOKS:

1. Dr. B. C. Punmia, Ashok K. Jain and Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, Sixteenth Edition, 2016.
2. T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008.

REFERENCES:

1. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, Mc Graw Hill 2001.
3. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004.
4. S. K. Roy, Fundamentals of Surveying, Second Edition, Prenticeˆ Hall of India2010.
5. K. R. Arora, Surveying Vol I & II, Standard Book house, Twelfth Edition 2013.
6. C. Venkatramaiah, Textbook of Surveying, Universities Press, Second Edition, 2011.

AI3311 FLUID MECHANICS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- Students should able to verify the principles studied in theory by performing the experiments in the laboratory

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

TOTAL: 60 PERIODS

REFERENCES:

1. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2015.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House. New Delhi, 2017.
3. Subramanya K, Fluid Mechanics and Hydraulic Machines, Tata McGraw Hill Edu. Pvt. Ltd.2011

COURSE OUTCOMES:

On completion of the course, the student is expected to

- Apply Bernoulli equation for calibration of flow measuring devices.
- Measure friction factor in pipes and compare with Moody diagram
- Determine the performance characteristics of rotodynamic pumps.
- Determine the performance characteristics of positive displacement pumps.

LIST OF EQUIPMENT REQUIRED

1. Rotameter – 1 no.
2. Venturimeter – 1 no.
3. Orificemeter – 1 no.
4. Pitot tube – 1 no.
5. Bernoulli's theorem apparatus – 1 no.
6. Triangular notch and Rectangular notch – 1 each (with a lined open channel setup)
7. Coefficient of friction apparatus
8. Pipe setup with bends, fittings and elbows for estimating minor losses
9. Centrifugal pump, Reciprocating pump, Submersible pump, Jet pump – 1 each
10. Collecting tank, Stop watch – 1 no. for each experiment

AI3312 SOIL SCIENCE LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- Students should able to verify various quality aspects of soil and water studied in theory by performing experiments in the laboratory.

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: 45 PERIODS

REFERENCES:

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.

COURSE OUTCOMES:

On completion of the course, the student is expected to

1. Explain soil physical properties and compare the properties based on soil and water system
2. Analyse the soil chemical properties to classify the arable and problem soils to develop different reclamation practices

CE3361 SURVEYING AND LEVELLING LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- At the end of the course the student will possess knowledge about survey field techniques

LIST OF EXPERIMENTS:

Chain Survey

1. Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset
2. Setting out works – Foundation marking using tapes single Room and Double Room

Compass Survey

3. Compass Traversing – Measuring Bearings & arriving included angles

Levelling - Study of levels and levelling staff

4. Fly levelling using Dumpy level &Tilting level
5. Check levelling

Theodolite - Study of Theodolite

6. Measurements of horizontal angles by reiteration and repetition and vertical angles
7. Determination of elevation of an object using single plane method when base is Accessible/inaccessible.

Tacheometry – Tangential system – Stadia system

8. Determination of Tacheometric Constants
9. Heights and distances by stadia Tacheometry
10. Heights and distances by Tangential Tacheometry

Total Station - Study of Total Station, Measuring Horizontal and vertical angles

11. Traverse using Total station and Area of Traverse
12. Determination of distance and difference in elevation between two inaccessible points using Total station

TOTAL: 45 PERIODS

COURSE OUTCOMES

On completion of the course, the student is expected to

CO1 Impart knowledge on the usage of basic surveying instruments like chain/tape, compass and levelling instruments
CO2 Able to use levelling instrument for surveying operations
CO3 Able to use theodolite for various surveying operations
CO4 Able to carry out necessary surveys for social infrastructures
CO5 Able to prepare planimetric maps

REFERENCES:

1. T. P. Kanetkarand S. V. Kulkarni, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 24th Reprint, 2015.
2. Dr. B. C. Punmia, Ashok K. Jainand Arun K Jain, Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 17th Edition, 2016.
3. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, Seventh Edition, McGraw Hill 2001
4. Bannisterand S. Raymond, Surveying, Seventh Edition, Longman 2004 a. David Clark, Plane and Geodetic Surveying for Engineers, Volume I, Constable and Company Ltd, London, CBS, 6th Edition, 2004.
5. David Clark and James Clendinning, Plane and Geodetic Surveying for Engineers, VolumeII, Constable and Company Ltd, London, CBS, 6th Edition, 2004.
6. S. K. Roy, Fundamentals of Surveying, Second Edition, Prentice 'Hall of India 2004
7. K. R. Arora, Surveying Vol. I & II, Standard Book house, Eleventh Edition, 2013.

AI3401 TRACTORS AND ENGINE SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the students to the different systems and working principles of tractor, power tiller, makes of tractors and power tillers.

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

TEXT BOOKS:

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

REFERENCES:

1. Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units. Wiley Eastern Pvt. Ltd., New Delhi, 1997.
2. Domkundwar A.V. A course in internal combustion engines. Dhanpat Rai & 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.
5. Jagadeeshwar Sahay, Elements of Agricultural Engineering, Standard Publishers Co., New Delhi, 2010.

COURSE OUTCOMES:

On completion of the course, the student is expected to

- Get an idea on various machinery available for farm mechanization
- Calculate the valve timing of an IC engine and represent by a drawing
- Gain knowledge on the transmission system of a tractor
- Understand the hydraulic system in a tractor and estimate the traction.
- Gain knowledge on power tillers, bulldozers and different tractor testing procedures.

AI3402 SOIL AND WATER CONSERVATION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- Get a sound knowledge in the problems associated with soil erosion.
- Introduce the estimation of soil erosion.
- Impart knowledge in various practices to control erosion.
- Study about the water conservation principles and techniques.
- Get an idea about sedimentation and its control measures.

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 WATER CONSERVATION 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

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.

REFERENCES:

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

COURSE OUTCOMES:

On completion of the course, the student is expected to

- Gain fundamental knowledge on the concepts of erosion and sedimentation.
- Gain knowledge about evolution of Universal Soil Loss Equation: and its applications.
- Explain and design erosion control measures types and design specifications
- Have sufficient knowledge on soil and water conservation measures.
- Have sufficient knowledge on reservoir sedimentation and sediment control methods.

AI3403 STRENGTH OF MATERIALS FOR AGRICULTURAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To understand the stresses developed in bars, compound, bars, beams, shafts, cylinders and spheres.

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

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

REFERENCES:

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, Jr. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing „co. Ltd., New Delhi, 2005.

OUTCOMES:

On completion of the course, the student is expected to

- Find the stress distribution and strains in regular and composite structures subjected to axial loads.
- Evaluate the stresses in plane trusses
- Assess the shear force, bending moment and bending stresses in beams
- Apply torsion equation in design of circular shafts and helical springs
- Evaluate the slope and deflection of beams and buckling loads of columns under different boundary conditions

CE3691 HYDROLOGY AND WATER RESOURCES ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To introduce to the students, the concepts of hydrological processes, hydrological extremes and groundwater.
- To prepare the students to quantify, regulate and manage water resources.

UNIT I PRECIPITATION AND ABSTRACTIONS 9

Hydrological cycle - Meteorological measurements – Types and forms of precipitation - Rain gauges - Spatial analysis of rainfall data using Thiessen polygon and Iso-hyetal methods - Interception – Evaporation: Measurement, Evaporation suppression methods – Infiltration: Horton‟s equation - Double ring infiltrometer - Infiltration indices.

UNIT II RUNOFF 9

Catchment: Definition, Morphological characteristics - Factors affecting runoff - Run off estimation using Strange’s table and empirical methods - SCS-CN method – Stage discharge relationship - Flow measurements - Hydrograph – Unit Hydrograph – IUH.

UNIT III HYDROLOGICAL EXTREMES 9

Natural Disasters - Frequency analysis - Flood estimation - Flood management - Definitions of drought: Meteorological, Hydrological, Agricultural and Integrated - IMD method - NDVI analysis - Drought Prone Area Programme (DPAP).

UNIT IV RESERVOIRS 9

Classification of reservoirs - Site selection - General principles of design - Spillways -Elevation-Area-Capacity curve - Storage estimation - Sedimentation - Life of reservoirs – Rule curve.

UNIT V GROUNDWATER 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

TEXT BOOKS:

1. Subramanya K, "Engineering Hydrology"- Tata McGraw Hill, 2010
2. Jayarami Reddy P, "Hydrology", Tata McGraw Hill, 2008.

REFERENCES

1. David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007
2. Ven Te 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.
4. Bhagu R. Chahar, Groundwater Hydrology, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017.

COURSE OUTCOMES:

On completion of the course, the student is expected to

1. Define the hydrological processes and their integrated behaviour in catchments
2. Apply the knowledge of hydrological processes to address basin characteristics, runoff and hydrograph
3. Explain the concept of hydrological extremes and its management strategies
4. Describe the principles of storage reservoirs
5. Understand and apply the concepts of groundwater management

ME3391 ENGINEERING THERMODYNAMICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- Impart knowledge on the basics and application of zeroth and first law of thermodynamics.
- Impart knowledge on the second law of thermodynamics in analyzing the performance of thermal devices.
- Impart knowledge on availability and applications of second law of thermodynamics
- Teach the various properties of steam through steam tables and Mollier chart.
- Impart knowledge on the macroscopic properties of ideal and real gases.

UNIT I BASICS, ZEROTH AND FIRST LAW 9

Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.

UNIT II SECOND LAW AND ENTROPY 9

Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance.

UNIT III AVAILABILITY AND APPLICATIONS OF II LAW 9

Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High and low grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency

UNIT IV PROPERTIES OF PURE SUBSTANCES 9

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

UNIT V GAS MIXTURES AND THERMODYNAMIC RELATIONS 9

Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states - Generalized Compressibility Chart. Maxwell relations - TdS Equations - heat capacities relations - Energy equation, Joule-Thomson experiment - Clausius-Clapeyron equation.

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course the students would be able to

- Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.
- Apply the second law of thermodynamics in analyzing the performance of thermal devices through energy and entropy calculations.
- Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart
- Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.
- Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.

TEXTBOOKS:

1. Nag.P.K., “Engineering Thermodynamics”, 6th Edition, Tata McGraw Hill (2017), New Delhi.
2. Natarajan, E., “Engineering Thermodynamics: Fundamentals and Applications”, 2nd Edition (2014), Anuragam Publications, Chennai

REFERENCES:

1. Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.
2. Chattopadhyay, P, “Engineering Thermodynamics”, 2nd Edition Oxford University Press, 2016.
3. Rathakrishnan, E., “Fundamentals of Engineering Thermodynamics”, 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.
4. Claus Borgnakke and Richard E. Sonntag, “Fundamentals of Thermodynamics”, 10th Edition, Wiley Eastern, 2019.
5. Venkatesh. A, “Basic Engineering Thermodynamics”, Universities Press (India) Limited, 2007.

GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY L T P C
2 0 0 2

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, 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.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL : 30 PERIODS

TEXTBOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES :

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

AI3411 TRACTOR AND FARM ENGINES LABORATORY L T P C
0 0 2 1

OBJECTIVES:

- To make the students conversant with the anatomy of farm tractor and farm engines
- To make them understand the working principle of IC engines, clutch, gear box, differential and final drive

LIST OF EXPERIMENTS:

1. Identification and study of different components of diesel engine
2. Identification and study of different components of petrol engine
3. Method of working of diesel engine with the help of working models
4. Method of working of diesel engine with the help of working models
5. Dismantling and assembly of diesel engine
6. Dismantling and assembly of petrol engine
7. Study of clutch – components and method of working
8. Study of gear box – components and method of working
9. Study of differential and final drive– components and method of working
10. Study of braking system and steering system – components and method of working
11. Study of hydraulic system and PTO system in a tractor
12. Study of electrical system, instruments in the dash board and controls – components: dynamo, starting motor, battery, lights, horn, odometer, amperemeter, accelerator, brake, differential lock, PTO lever, hydraulic lever, draft and position control lever.

LIST OF EQUIPMENT REQUIRED

1. Working model of diesel engine
2. Working model of petrol engine
3. Working model of clutch
4. Working model of gear box
5. Working model of differential
6. Working model of final drive
7. Working model of brake system
8. Working model of steering system
9. Condemned tractor
10. Condemned diesel engine
11. Condemned petrol engine

REFERENCES:

1. Jagdishwar Sahay. 2019. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi.
2. Michael, A.M. and Ohja, T.P. 2018. Principles of Agricultural Engineering Volume I. Jain Brothers, Jodhpur.

COURSE OUTCOMES:

On completion of the course, the student is expected to

- Understand the working of tractors, power tillers and their functions.
- Identify and rectify problems in the functioning of tractors and power tillers.
- Summarize the ergonomics of tractors and power tillers.

AI3412 **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 and determination of their characteristics experimentally.

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 Hardness Tests)
7. Deflection test on metal beam
8. Compression test on helical spring
9. Deflection test on carriage spring

TOTAL: 60 PERIODS

REFERENCES:

1. Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
2. IS1786-2008 (Fourth Revision, Reaffirmed 2013), 'High strength deformed bars and wires for concrete reinforcement – Specification', 2008.

COURSE OUTCOMES:

1. Find the stress distribution and strains in regular and composite structures subjected to axial loads.
2. Assess the shear force, bending moment and bending stresses in beams
3. Apply torsion equation in design of circular shafts and helical springs

LIST OF EQUIPMENT 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
11.	Mortar cube moulds	10