

SCHEME OF STUDIES

BSc Agricultural Engineering



(With Effect from Session 2024 and onwards)

Approved by

Board of Studies of Agricultural Engineering in its meeting held on 28-03-2024

Board of Faculty of Agricultural Sciences and Technology held on 07-06-2024

Academic Council BZU in its 1/2024 meeting held on 12-06-2024

MARCH 28, 2024

DEPARTMENT OF AGRICULTURAL ENGINEERING
FACULTY OF AGRICULTURAL SCIENCES & TECHNOLOGY, BAHAUDDIN ZAKARIAYA UNIVERSITY, MULTAN

CURRICULUM

OF

AGRICULTURAL ENGINEERING

Bachelor of Engineering Program

(Revised 2024)

Pakistan Engineering Council
&
Higher Education Commission

Islamabad

1 PREFACE

The curriculum, with varying definitions, is said to be a plan of teaching-learning process that students of an academic program are required to undergo. Curriculum design is a critical component and backbone of the educational structure for any nation. It includes objectives and learning outcomes, course contents, scheme of studies, teaching methodologies and methods of learning assessment. In the advent of fast technological advancements and emergence of new disciplines, it requires that curricula should be dynamic having regular review and updating.

The University Grants Commission (UGC) was designated as the competent authority to develop, review and revise curricula beyond Class-XII vide Section 3, Sub-Section 2 (ii), Act of Parliament No. X of 1976 titled "Supervision of Curricula and Textbooks and Maintenance of Standard of Education". With the repeal of UGC Act, the same function was assigned to the Higher Education Commission (HEC) under its Ordinance of 2002, Section 10, Sub-Section 1 (v). In compliance with the above provisions, the HEC has been undertaking the development of curricula for new/ emerging fields and revision of existing curricula after every three to five years through respective National Curriculum Revision Committees (NCRCs) until 2018.

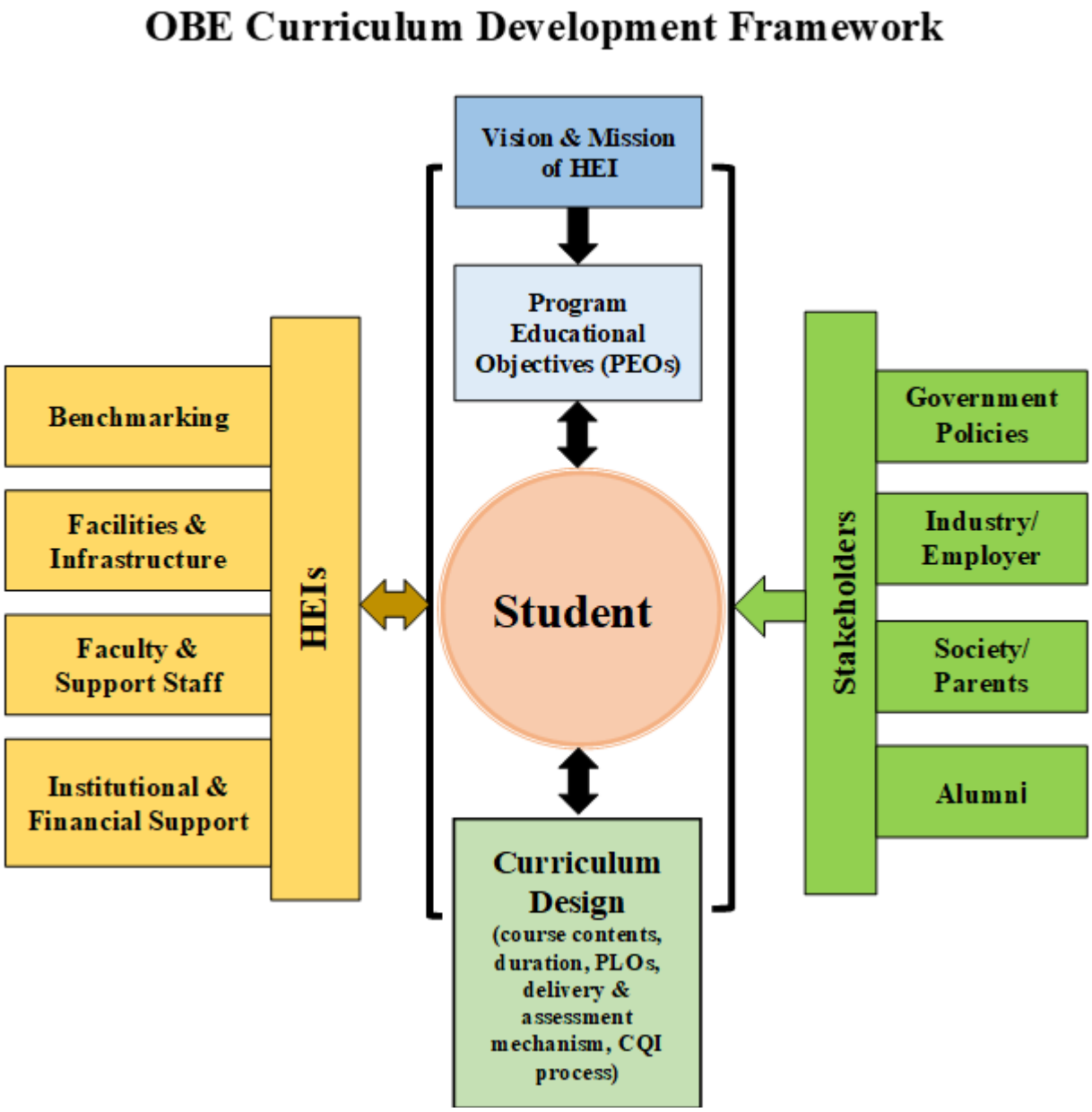
As a policy change and expanding higher education base under HEC, the curriculum review and development task has been shifted to the respective regulators and HEIs. PEC also having mandate under its PEC Act 1976 and especially after attaining Washington Accord full signatory status and IPEA licensing authority, took up the challenge to review and develop the curricula for engineering programs following Outcome-Based Education (OBE) System. PEC has therefore constituted an Engineering Curriculum Review and Development Committee (ECRDC) and also subject ECRDCs comprising of eminent engineers and professionals from academia and industry to take up the task of curricula review and updation, in consultation with all relevant stakeholders. Nevertheless, the basic templates developed by HEC NCRCs have been followed as guidelines.

Under OBE based curriculum review and development framework, PEC held national and regional level stakeholders and industrial consultation workshops by engaging HEIs, industry, technical and consulting organizations. The experts' feedback and suggestions were translated

into the curriculum review process taking into consideration the dynamics of technological advancement, industrial needs and management-cum-soft skills for engineering graduates.

This curriculum document would therefore serve as a guideline whereas allowing HEIs to tame/ change within the framework by introducing courses in support of local/ required industrial demand as well as satisfying 12 GAs (Graduate Attributes) covering core and elective courses, considered as beauty of OBE system in the international environment. At the same time, this curriculum framework would fulfill our national, social and economic needs leading towards attainment of Sustainable Development Goals (SDGs-2030). It would also provide the level of competency specified in Framework making it compatible with national and international educational standards.

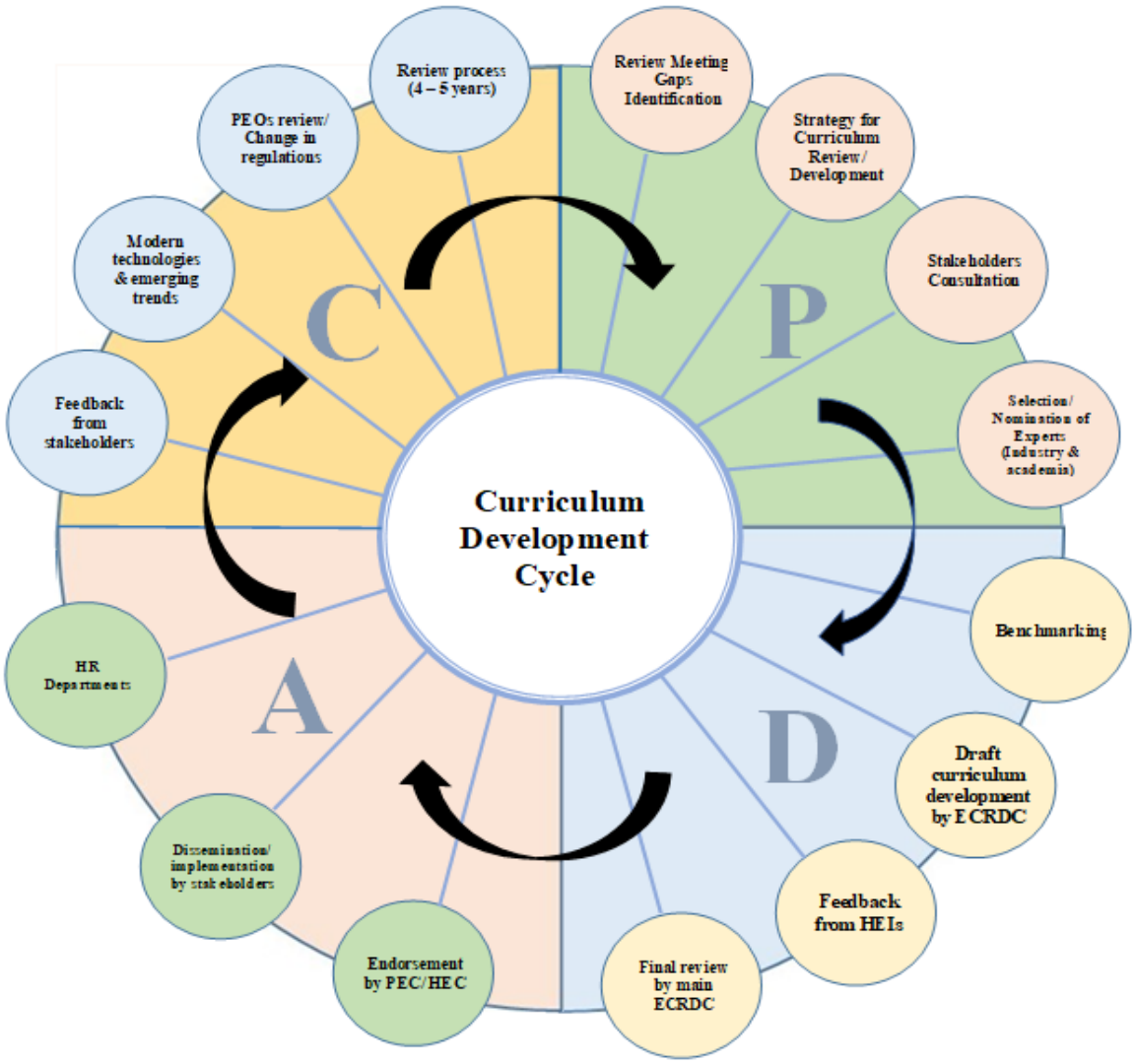
2 Outcome Based Education (OBE) - Curriculum Development Framework



Outcome Based Education (OBE) is an approach of teaching and learning that focuses on what students should be able to do/ attain at the end of the educational program. OBE is a student's centered system which concerns what the students will know and be able to do as learning outcomes. The curriculum development under OBE is therefore an integration of graduate's attributes and stakeholders' feedback in cognizance with institution's Vision and Mission.

3 PDCA Approach to Curriculum Design and Development

The process of curriculum design and development constitutes various interconnected elements with the objective of achieving the intended purpose of the program. The Plan-Do-Check-Act approach (PDCA) as explained below has been followed in the curriculum development and review process.



Plan. This stage begins with an analysis of the stakeholders' needs of faculty, current and past students, employers and society in general. The stakeholders' needs are translated into human resource terminology i.e. graduate competencies which in turn translated into educational

taxonomy i.e. learning outcomes. Based on the learning outcomes, curriculum is designed backward to meet them.

Do. The plan stage is implemented where curriculum is delivered and learning outcomes are assessed to gauge the achievement of them.

Check. This stage involves the analysis of assessment results and feedback from students and faculty. Areas for improvement are identified.

Act. When the learning outcomes are achieved, the curriculum, learning and teaching strategies and assessment methods are standardized. Best practices are shared and improvement is made for the next cycle of PDCA.

4 Program Objectives (PEOs) and Learning Outcomes (PLOs)

As guidance, the sample Program Educational Objectives (PEOs) and Learning Outcomes (PLOs) are given below for a typical Agricultural Engineering Program. The HEIs should have their own program objectives (PEOs) and PLOs inline with the institution's Vision and Mission, in cognizance with industrial needs as well as national and international trends.

7.1 Program Educational Objectives (PEOs)

4.1.1 PEOs devised by PEC

The program aims at imparting quality education to agricultural engineering graduates for contributing to the society through modern technologies and practices.

After graduation, the Agricultural Engineers are expected to;

1. Demonstrate sound engineering knowledge and skills.
2. Execute and manage teamwork, interpersonal skills and professional growth.
3. Conduct professional practice considering societal, ethical, and environmental aspects.

4.1.2 PEOs implemented by Agricultural Engineering Department, BZU

The Program will prepare and produce graduate Agricultural Engineers who will be able to:

1. Demonstrate sound Agricultural Engineering knowledge and skills in public and private sectors at national and international level.
2. Execute and manage teamwork, interpersonal skills, and professional growth in the field of Agricultural Engineering.
3. Conduct Agricultural Engineering professional practice considering societal, ethical, and environmental aspects.

7.2 Program Learning Outcomes (PLOs)

Program outcomes are the narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills and attitude that the students acquire while progressing through the program. Specifically, it is to be demonstrated that the students have acquired the following graduate attributes (GAs):

PLO1 - Engineering Knowledge: An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PLO2 - Problem Analysis: An ability to identify, formulate, search literature, and analyze complex engineering problems reaching substantiated conclusions using principles of mathematics, natural and engineering sciences.

PLO3 - Design/Development of Solutions: An ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PLO4 - Investigation: An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive firm conclusions.

PLO5 - Modern Tool Usage: An ability to 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.

PLO6 - The Engineer and Society: An ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.

PLO7 - Environment and Sustainability: An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

PLO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PLO9 - Individual and Team Work: An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

PLO10 - Communication: An ability to communicate effectively, orally as well as in writing, 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.

PLO11 - Project Management: An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.

PLO12 - Lifelong Learning: An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

8. Program Salient Features

The undergraduate engineering program has been based on the following salient features:

- **Duration:** 4 years
- **Number of Semesters:** 8
- **Total number of credit hours**: 136
    - Engineering Domain: 89 credit hours

- Non-Engineering Domain: 47 Credit Hours

(HIEs have flexibility of 15-21 Credit Hours to add courses either in Engineering, Non-Engineering or both Domains to fulfill the program objectives in line with the overall Vision/ Mission of the Institute concerned).

- **Number of weeks per semester**: 16
- **Number of credit hours per semester**: 16 - 18
- **Curriculum:** The engineering curriculum is the most important instrument for grooming the students based on 12 Graduate Attributes (GAs) encompassed under the Program Learning Outcomes (PLOs).

8.1 Knowledge Profile

In order to inculcate different dimensions of thinking – mathematical, computational, design and creative – among students in Cognitive, Psychomotor and Affective domains, the curriculum is based on the following knowledge profiles:

WK1 - Natural Sciences: A systematic theory-based understanding of natural sciences applicable to the discipline.

WK2 - Mathematics and Computing: The concept-based mathematical thinking, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline.

WK3 - Engineering Fundamentals: A systematic, theory-based formulation of engineering fundamentals required in an engineering discipline.

WK4 - Engineering Specialization: The knowledge of Engineering specialization that provides theoretical frameworks and bodies of knowledge for the accepted practice areas that are at the forefront in a discipline.

WK5 - Engineering Design: The Design Thinking Knowledge that supports engineering design in a practice area of an engineering discipline.

WK6 - Engineering Practice: The Knowledge of engineering practices (technology) in different practice areas of an engineering discipline.

WK7 - Engineering in Society: A systematic, comprehension-based knowledge of the role of engineers in a society and the professional issues related to practicing engineering profession in a discipline: ethics and the professional responsibility of an engineer to public safety including the impact of an engineering activity i.e. economic, social, cultural, environmental and sustainability

WK8 - Research Literature: Engagement with selected knowledge in the research literature of the discipline.

The curriculum matrix covering above knowledge profiles should therefore be composed of non-engineering domain (humanities, math, management and natural sciences), and engineering domain with computer science, foundation, breadth, depth and multidisciplinary courses so that different streams could be encouraged within each discipline, enabling students to undertake a range of **Complex Problem Solving** and **Complex Engineering Activities**. The students may select electives from any of the streams with guidelines from their respective advisors.

Knowledge Profile (WK-1 to WK-8)*	Knowledge Area	Sub-Area	Courses	Credit Hours
Non-Engineering Domain/General Education				
WK-2	**Natural Science**	Math	As per program requirements	12 - 15
WK-1		Physics	Applied Physics	6 - 9
		Chemistry	Applied Chemistry	
		Natural Science/ Math Elective		
WK-7	**Humanities**	English	Courses covering functional English, communication skills, technical writing and presentation skills	4 - 7
		Culture	Islamic Studies and Ethics	2
			Pakistan Studies and Global Perspective	2
		Social Science	Courses covering: sociology for engineering profession and practice, community engagement and engineers role in societal development, Health & Safety	2 - 6
	Management Sciences	Professional Practice	Courses covering: Engineering Project Management, Entrepreneurship, Quality Management	2 - 6
Total (Non-Engineering Domain)				**min 38**

<table>
<tr><th colspan="5">Engineering Domain</th></tr>
<tr><th>Knowledge Profile</th><th>Knowledge Area</th><th>Sub-Area</th><th>Courses</th><th>Credit Hours</th></tr>
<tr><td>WK-2/WK-4/WK-5/ WK-6</td><td>Computer Science</td><td>ICT/AI/ Data Science/ Cyber Security</td><td></td><td>6 - 9</td></tr>
<tr><td>WK-3/WK-2</td><td>Foundation Engg Courses</td><td></td><td>Specific to Program objectives and outcomes</td><td>22 - 24</td></tr>
<tr><td>WK-4/WK-2/ WK-1</td><td>Core Breadth of Engg discipline</td><td></td><td>Specific to Program objectives and outcomes</td><td>22 - 24</td></tr>
<tr><td>WK-5/WK-6</td><td>Core Depth of Engg Discipline</td><td></td><td>Specific to Program objectives and outcomes</td><td>22 - 24</td></tr>
<tr><td rowspan="2">WK-1/WK-2/WK-3/WK-4,</td><td rowspan="2">Multidisciplinary Engg Courses</td><td rowspan="2"></td><td>Specific to Program objectives and outcomes</td><td rowspan="2">6 - 12</td></tr>
<tr><td>Occupational Health and Safety (Mandatory-01 Cr. Hr)</td></tr>
<tr><td>WK-6/WK-7/ WK-8</td><td>Final Year Design Project (FYDP/ Capstone</td><td colspan="2">Integration of innovative, creative, technical, management and presentation skills of a graduate towards final year.</td><td>6</td></tr>
<tr><td>WK-6/WK-7</td><td>Industrial Training</td><td colspan="2">Atl east 6 - 8 weeks mandatory internship</td><td>Qualifying</td></tr>
<tr><td>WK-4, WK-5, WK-6, WK-7, WK-8, WK-2</td><td colspan="4">Innovative and Critical Thinking (under relevant course):
- Complex Problem Solving
- Complex Engineering Activities
- Semester Project/ Case Studies
- Open ended labs
-Problem-based learning (PBL)</td></tr>
<tr><td colspan="5">Flexible Engineering/Non-Engineering Courses</td></tr>
<tr><td></td><td colspan="2">Flexible Engineering/Non-Engineering Courses (may be</td><td></td><td>8-14</td></tr>
</table>

	adjusted as per program requirements		
Total (Engineering domain)			**min 84**
Total (Credit Hours)			**130 - 136**

*As a specific or more than one knowledge profile to be covered.

- **Industrial Training:** Internship of at least 6 - 8 weeks is mandatory part of degree requirements towards 3rd to 4th year of program; must be supervised, monitored, evaluated, and reflected in the transcripts under a prescribed mechanism and with defined and mapped rubrics with program objectives.
  - Selection of internship in line with elective subjects/ specific streams
  - Qualifying weightage: 70%
    - At least 75% attendance is mandatory 10%
    - Assessment report from the employer 50%
    - Evaluation at relevant HEIs/ Deptt – presentation 40%
- **Final Year Design Project (FYDP)/ Capstone:** FYDP aims to challenge innovative, creative, technical, management and presentation skills of a graduate to bring together the learning over the degree program.
  - A final year design project (FYDP) is the confluence of an engineering program. Undertaking a final year design project is a compulsory requirement. It should mainly comprise literature search, individual analysis, modeling and simulation, AI (Artificial Intelligence) and computational data analytics, design and putting together various hardware, software, firmware and Algorithm Engineering / Informatics related to the program to demonstrate a functional concept including rapid prototyping, where applicable.
  - The FYDP shall include complex engineering problems and design systems, components or processes integrating core areas and meeting specific needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
  - A project of this nature should invariably lead to an integration of the knowledge and practical skills as mandated in the program outcomes. In this context, projects of multidisciplinary nature should be encouraged.
  - The FYDP should span over two consecutive semesters, i.e. semester 7 & 8, totaling 6-credit hours and should be fully supervised, assessed and reflected in the transcripts under a prescribed mechanism so as to prepare for joining industry after graduation.

- **Faculty:** The faculty must be trained for the Outcome-Based Education (OBE) system. Their familiarity with the program objectives and outcomes, understanding of the Outcome-Based Assessment (OBA) cycle, enthusiasm for developing an effective program, and the ability to become an active player in this regard are the keys to ensure the attainment of program objectives. The faculty is expected to have the ability to ensure proper implementation of the program, and to develop processes for evaluation, assessment and CQI. A formal training program to groom the faculty to become effective instructors in applying pedagogical skills in all aspects of Teaching, Learning and Assessment covering all domains of Knowledge, Skills and Attitude.
- **Personal Grooming:** Personal Grooming of young faculty members and students is very important to develop and support their professional skills. Therefore, it is required that HEIs should conduct/arrange sessions or counseling hours on regular basis to provide guidance for personal grooming. Personal Grooming is important for positive self-image and increasing the confidence level of the individuals. It would help in enhancing students' self-esteem and would go a long way in developing an attractive personality by adopting habits like personal hygiene, clothing, appearance, interaction, and expressive skills, etc.
  This curriculum has been designed to guide and facilitate the universities and departments to formulate their own programs according to the industrial needs, emerging trends and recent developments in the field of Agricultural Engineering. The HEIs have flexibility to incorporate changes in the proposed curriculum within given range of credit hours for engineering and non-engineering domain.

9. Framework for Bachelor of Agricultural Engineering

Framework for BSc Agricultural Engineering is designed to as per guidelines of the PEC communicated vide letter No. PEC/EAD/P&C/UEP/2023 dated September 27, 2023 and is available at Annexure-I

Knowledge Profile	Knowledge Area	Sub-Area	Course Title	Theory	Lab	Total
				Credit Hours		
General Education/Non-Engineering Domain						
WK-7	Humanities	English	Functional English	3	0	3
			Expository Writing/ Technical Writing and Presentation Skills	3	0	3
		Total English (Minimum required 4-7 credit hrs)		**6**	**0**	**6**
		Culture	Islamic Studies/ Ethics for non-Muslims	2	0	2
			Ideology and Constitution of Pakistan	2	0	2
			Arts & Humanities (Languages or study of religion)	0	0	0
		Total Culture (Minimum required 2+2 credit hrs)		**4**	**0**	**4**
		Social Science	Economics for Engineers	2	0	2
			Information and Communication Technologies (ICT)	1	1	2

			Civics and Community Engagement	2	0	2
		Total Social Science (Minimum required 2-6 credit hrs)		**5**	**1**	**6**
	Management Sciences	Professional Practice	Elective-I (Engg Project Management/ Engg Management)	2	0	2
			Elective-II (Entrepreneurship)	2	0	2
		Total Management Sciences (Minimum required 2-6 credit hrs)		**4**	**0**	**4**
WK-2	Natural Sciences	Mathematics	Quantitative Reasoning I/ Calculus and Analytical Geometry	3	0	3
			Quantitative Reasoning II/ Linear Algebra	3	0	3
			Advanced/Applied Mathematics Courses			
			Probability and Statistics	3	0	3
			Numerical Analysis	2	1	3
			Total Credit Hours for Math's Courses (Minimum required 12-14 credit hours)	**11**	**1**	**12**
WK-1		Physics	Applied Physics	2	1	3
		Chemistry	Industrial Chemistry	2	1	3
		Total Physics & Chemistry (Minimum required 6-9)		**4**	**2**	**6**

Total (General Education/Non-Engineering Domain) (Minimum required 38)				**30**	**8**	**38**
Engineering Domain						
Knowledge Profile	**Knowledge Area**	**Sub-Area**	**Course Title**	**Theory**	**Lab**	**Total**
WK-2/WK-4/WK-5/WK-6	Computer and Information Science	ICT/ AI/ Data Sciences/ Cyber Security	Computer Programming (Python, or latest)	2	1	3
			GIS and Remote Sensing	2	1	3
		Total Computer and Information Science (Minimum required 6-9 credit hrs)		**4**	**2**	**6**
WK-3/ WK-2	Engineering Foundation		Engg Mechanics	2	1	3
			Engg Drawing & Graphics	1	1	2
			Metallurgy and Workshop Practices	1	1	2
			Computer Aided Drawing	1	1	2
			Applied Thermodynamics	2	1	3
			Fluid Mechanics	2	1	3
			Surveying and Levelling	2	1	3
			Instrumentation and Control	2	1	3
			Manufacturing Engineering	1	1	2
		Total Engineering Foundation		**14**	**9**	**23**

		(Minimum required 22-24 credit hrs)				
WK-4/ WK-2/ WK-1	Core Breadth of Engg discipline		Soil Mechanics	2	1	3
			Strength of Materials	2	1	3
			Engineering Hydrology	2	1	3
			Earth Moving Machinery	1	1	2
			Solid Waste Management	2	1	3
			Agricultural Process Engineering	2	1	3
			High Efficiency Irrigation Systems	1	1	2
			Environmental Engineering	2	1	3
			Engg Elective-I	1	1	2
		Total Core Breath of discipline **(Minimum required 22-24 credit hrs)**		**15**	**9**	**24**
WK-5/ WK-6	Core Depth of Engg discipline		Machine Design	2	1	3
			Farm Machinery and Automation	2	1	3
			Open Channel Hydraulics	2	1	3
			Irrigation Engineering	2	1	3
			Drainage Engineering	2	1	3
			IC Engines and Tractors	2	1	3
			Engg Elective-II	2	1	3
			Engg Elective-III	2	1	3

		Total Core Depth of Engg. Discipline **(Minimum required 22-24 credit hrs)**		16	8	24
Total (Engineering Domain) Minimum required 72 credit hours				**49**	**28**	**77**
WK-3/ WK-4/ WK-2/ WK-1	Multi-disciplinary engineering courses (MDE)		MDE-I (Wastewater Engineering)	2	1	3
			MDE-II (Alternate and Renewable Energy(ARE))	1	1	2
			Occupational Health and Safety	1	0	1
Total (multi-disciplinary engineering courses (MDE)) Minimum required 6-12 credit hours				**4**	**2**	**6**
WK-6/ WK-7/ WK-8			FYDP (Part-I)	0	3	3
			FYDP (Part-II)	0	3	3
Total Final Year Design Project Minimum required 6 credit hours				**0**	**6**	**6**
WK-6/ WK-7	Industrial Training	At least 6-8 weeks Internship **(Mandatory and Qualifying only)**		0	0	0
WK-2/ WK-4/ WK-5/ WK-6	**Innovative and Critical Thinking (under relevant courses** -Complex Problem Solving -Complex Engineering Activities -Semester Project -Case Studies -Open ended labs -Problem-based learning (PBL)					
			Total (Engineering domain) (Minimum credit hours required 84)	**53**	**36**	**89**
Flexible Engineering/Non-Engineering Courses						
WK-4/ WK-2/ WK-1	Core Breadth of Engg discipline		Farm Structures and Control Sheds	2	1	3

			Pumps and Tubewells	1	1	2
WK-1	Natural Sciences	Agricultural Sciences	Basic Agriculture	1	1	2
			Soil Science	1	1	2
Total (Engineering/Non-Engineering Courses) **(Minimum credit hours required 8-14)**				**5**	**4**	**9**
Total (Credit Hours)				**89**	**47**	**136**

9.2 Non-Credit Hours Courses (Mandatory and Qualifying only)

Sr. No.	Course No.	Couse Title	Semester
1	CHM-101	Fundamentals of Chemistry (for the students having ICS background)	1st
2	ARAB-151	Translation of the Holy Quran I	1st
3	ARAB-152	Translation of the Holy Quran II	2nd
4	ARAB-251	Translation of the Holy Quran III	3rd
5	ARAB-252	Translation of the Holy Quran IV	4th
6		Survey Camp **(Mandatory and Qualifying only)**	Summer Break after 4thSemester
7	ARAB-351	Translation of the Holy Quran V	5th
8	ARAB-352	Translation of the Holy Quran VI	6th
9		At least 6-8 weeks Internship **(Mandatory and Qualifying only)**	Summer Break after 6th Semester
10	ARAB-451	Translation of the Holy Quran V	7th
11	ARAB-452	Translation of the Holy Quran VI	8th

10 Bachelor of Agricultural Engineering at BZU

10.2 University Vision

The University is expected to be immensely **innovative** in fostering world-class **research** and becoming a **vital agent for the regional development.**

10.3 University Mission

We aspire to be **innovative** in fostering world-class excellence in diverse academic disciplines developing into a **vital player** gathering **knowledge** and conducting **research** to **benefit people** of Pakistan in particular, regional countries in general and world at large

10.4 Department Vision

The vision of the department is to become a world class engineering entity for training and developing top class Agricultural engineers for the nation and the world.

10.5 Department Mission

The mission of the Department is to be a center of excellence in teaching, research and extension education in the discipline of agricultural engineering so as:

- To promote undergraduate and graduate students learning in agricultural engineering
- To discover and improve new technologies for all stakeholders
- To provide engineering and technology expertise in the fields of agriculture and industry for the nation and world.

10.6 Program Educational Objectives of BSc Agricultural Engineering Program at BZU

Program educational objectives (PEOs) are broad statements that describe what graduates are expected to achieve a few years after graduation.

The Program will prepare and produce graduate Agricultural Engineers who will be able to:

1. Demonstrate sound Agricultural Engineering knowledge and skills in public and private sectors at national and international level.
2. Execute and manage teamwork, interpersonal skills, and professional growth in the field of Agricultural Engineering.
3. Conduct Agricultural Engineering professional practice considering societal, ethical, and environmental aspects.

10.6.1 Key Performance Indicators for measuring PEOs

PEO No.	KPI	Measurement Tool
PEO 1	At least 70% of respondent employers would be satisfied with the competence level (knowledge and skills) of employed graduates to meet their needs.	Employer Survey
	At least 70% respondent alumni would be satisfied with their acquired knowledge and skills.	Alumni Survey & Exit Survey
PEO 2	At least 70% of respondent employers would be satisfied with the interpersonal skills and professional growth of employed engineers	Employer Survey
	At least 70% of respondent internship providers would be satisfied with the teamwork and interpersonal skills of the students.	Internship Feedback
	At least 70% respondent graduates are involved in one or more continuing professional development (CPD) or continuing professional education (CPE) activity	Alumni Survey
PEO3	At least 30% of the respondent graduates are involved in activities/projects related to societal, ethical, and environmental issues.	Alumni Survey

10.6.2 Course Mapping with PEOs

Sr. No.	Course Code	Course Title	1	2	3
			PEO1	PEO2	PEO3
First Semester					
1	SEE-101	Engineering Drawing & Graphics	√	√	√
2	CSC-101	Information and Communication Technologies (ICT)	√	√	
3	SEE-103	Surveying and leveling	√		√
4	MAT-101	Calculus and Analytical Geometry	√	√	
5	ENG-101	Functional English		√	√
6	ISL-101	Islamic Studies and Ethics		√	√
7	CHM-101	Fundamentals of Chemistry (for the students having ICS background)	√	√	
8	ARAB-151	Translation of the Holy Quran I			√
Second Semester					
1	I&D-102	Fluid Mechanics	√		
2	FMP-102	Metallurgy and Workshop Practices	√		√
3	PHY-102	Applied Physics	√	√	
4	SEE-104	Computer Aided Drawing	√		√
5	AGR-101	Basic Agriculture	√	√	
6	MAT-102	Linear Algebra	√		
7	ENG-102	Technical Writing and Presentation Skills		√	√
8	ARAB-152	Translation of the Holy Quran II			√
Third Semester					
1	I&D-201	Soil Mechanics	√	√	
2	SEE-201	Engineering Mechanics	√	√	√
3	FMP-201	Applied Thermodynamics	√		
4	FMP-203	Manufacturing Engineering	√		√
5	CHM-102	Industrial Chemistry	√		√
6	CSC-201	Computer Programming	√		√
7	ARAB-251	Translation of the Holy Quran III			√
Fourth Semester					

1	I&D-202	Open Channel Hydraulics	√		√
2	SEE-202	Strength of Materials	√		√
3	SEE-204	Environmental Engineering	√	√	√
4	FMP-202	Instrumentation and Control	√	√	
5	AEN-202	Occupational Health and Safety		√	√
6	SES-202	Soil Science		√	√
7	SSH-202	Ideology and constitution of Pakistan		√	√
8	ARAB-252	Translation of the Holy Quran IV			√
Fifth Semester					
1	I&D-301	Pumps and Tubewells	√	√	
2	FMP-301	IC Engines and Tractors	√	√	
3	FMP-303	Machine Design	√	√	√
4	SEE-301	MDE Elective-I (Wastewater Engineering)	√	√	
5	MAT-301	Probability and statistics	√	√	√
6	SSH-301	Civics and Community Engagement			√
7	ARAB-351	Translation of the Holy Quran V			√
Sixth Semester					
1	I&D-302	Engineering Hydrology	√	√	
2	I&D-304	Irrigation Engineering	√		√
4	I&D-306	High Efficiency Irrigation Systems	√	√	
5	FMP-302	Earth Moving Machinery	√	√	√
6	MSC-302	Management Elective-I (Engineering Project Management)	√	√	√
5	MAT-304	Numerical Analysis	√	√	
7	SSH-302	Social Sci Elective-II (Economics for Engineers)			√
8	ARAB-352	Translation of the Holy Quran VI			√
Seventh Semester					
1	I&D-401	GIS & Remote Sensing	√	√	
2	SEE-401	Solid Waste Engineering	√	√	√
3	FMP-401	Agricultural Process Engineering	√	√	
4	FMP-403	Farm Machinery and Automation	√	√	
5	I&D/SEE-FMP-	Engg Elective-I			

6	AEN-401	Final Year Design Project (FYDP)-I	√	√	√
7	MSC-401	Management Elective-II (Entrepreneurship)	√	√	√
8	ARAB-451	Translation of the Holy Quran VII			√
Eighth Semester					
1	I&D-402	Drainage Engineering	√	√	√
2	SEE-402	Farm Structures and Control Sheds	√	√	
3	FMP-402	MDE Elective-II (Alternate and Renewable Energy (ARE))	√	√	
4	I&D/SEE/ FMP-	Engg. Elective-II	√	√	√
5	I&D/SEE/ FMP-	Engg. Elective-III	√	√	√
6	AEN-402	Final Year Design Project (FYDP) -II	√	√	√
7	ARAB-452	Translation of the Holy Quran VII			√

10.6.3 Course Mapping with PLOs

Sr. No.	Course Code	Course Title	1 Engineering Knowledge	2 Problem Analysis	3 Design/Development of Solution	4 Investigation	5 Modern Tool Usage	6 The Engineering and Society	7 Environment and Society	8 Ethics	9 Individual and Teamwork	10 Communication	11 Project Management and Finance	12 Lifelong Learning
First Semester														
1	SEE-101	Engineering Drawing & Graphics	C2		P4						A2			
2	CSC-101	Information and Communication Technologies (ICT)	C2				P3					C2		
3	SEE-103	Surveying and leveling	C1 C2	C3							P3			
4	MAT-101	Calculus and Analytical Geometry	C2	P2	C3									
5	ENG-101	Functional English						C2				A2		C2
6	ISL-101	Islamic Studies and Ethics						A3		C1 A4		P1		A3 A4
7	CHM-101	Fundamentals of Chemistry (for the students having ICS background)	C2	C4				C3			P4			
8	ARAB-151	Translation of the Holy Quran I						C2		C1				C1 C2
Second Semester														
1	I&D-102	Fluid Mechanics	C2	C4	C3						P4			
2	FMP-102	Metallurgy and Workshop Practices	C1 C2								P2			
3	PHY-102	Applied Physics	C2	C3 P3			P4				C3			
4	SEE-104	Computer Aided Drawing	C2			P3								
5	AGR-101	Basic Agriculture		P1		C2		C1						
6	MAT-102	Linear Algebra	C2	C3		C3								

7	ENG-102	Technical Writing and Presentation Skills						C2				A2 A4		
8	ARAB-152	Translation of the Holy Quran II						C2		C1				C1 C2
Third Semester														
1	I&D-201	Soil Mechanics	C2	C3		P3								
2	SEE-201	Engineering Mechanics	C2	P2	C3						P3			
3	FMP-201	Applied Thermodynamics	C2 C3	C4 P3										
4	FMP-203	Manufacturing Engineering	C1 C2								P2			
5	CHM-102	Industrial Chemistry	C2			C3					P3			
6	CSC-201	Computer Programming	C2		C3	C4	-	-	-	-	-	-	-	-
7	ARAB-251	Translation of the Holy Quran III						C2		C1				C1 C2
Fourth Semester														
1	I&D-202	Open Channel Hydraulics	C2	C3	P3									
2	SEE-202	Strength of Materials	C2	C4			P4							
3	SEE-204	Environmental Engineering	C2			C5			C4		P3			
4	FMP-202	Instrumentation and Control	C2	C3							P2 P3			
5	AEN-202	Occupational Health and Safety	C2				P3							
6	SES-202	Soil Science	C2	C3					P3					
7	SSH-201	Ideology and constitution of Pakistan						C2				A5		A2
8	ARAB-252	Translation of the Holy Quran IV						C2		C1				C1 C2
Fifth Semester														
1	I&D-301	Pumps and Tubewells	C2	C3							P3			
2	FMP-301	IC Engines and Tractors	C2	C4							P4			
3	FMP-303	Machine Design	C4	C5			A3				P3			A3
4	SEE-301	MDE Elective-I (Wastewater Engineering)	C3	C2		C4 P4								
5	MAT-301	Probability and statistics	C2	C4 C2			C3							

6	SSH-301	Social Sci Elective-I (Civics and Community Engagement)						C2 C4 A3 A4						
7	ARAB-351	Translation of the Holy Quran III						C2		C1				C1 C2
Sixth Semester														
1	I&D-302	Engineering Hydrology	C2	C3 C4							P3			
2	I&D-304	Irrigation Engineering	C2	C3			P3				C4			
3	I&D-306	High Efficiency Irrigation System	C2			P2								
4	FMP-302	Earth Moving Machinery	C3			C4					P4			
5	MSC-302	Management Elective-I (Engineering Project Management)					C3						C2 P3	
6	MAT-304	Numerical Analysis	C2	C2 C3			C3							
7	SSH-302	Social Sci Elective-II (Economics for Engineers)						C2					C2	
8	ARAB-352	Translation of the Holy Quran VI						C2		C1				C1 C2
Seventh Semester														
1	I&D-401	GIS & Remote Sensing	C2			C3	P2							
2	SEE-401	Solid Waste Engineering	C2	C4		A3			P4					
3	FMP-401	Agricultural Process Engineering	C2		P3	C3								
4	FMP-403	Farm Machinery and Automation	C2 C3 C4								P4			
5	I&D/SEE-FMP-	Engg Elective-I												
6	AEN-401	Final Year Design Project (FYDP)-I			C5	C6	P5	A4	A3	A4	A3	A4	A4	A4
7	MSC-401	Management Elective-II (Entrepreneurship)						C4			C2 C5			
8	ARAB-451	Translation of the Holy Quran VII						C2		C1				C1 C2
Eighth Semester														

1	I&D-402	Drainage Engineering	C2			C3	P2				P3			
2	SEE-402	Farm Structures and Control Sheds	C2		P4	C3								
3	FMP-402	MDE Elective-II (Alternate and Renewable Energy (ARE))	C1 C2	P2										
4	I&D/SEE/ FMP-	Engg. Elective-II												
5	I&D/SEE/ FMP-	Engg. Elective-III												
6	AEN-402	Final Year Design Project (FYDP) -II			C5	C6	P5	A4	A3	A4	A3	A4	A4	A4
7	ARAB-452	Translation of the Holy Quran VII						C2		C1				C1 C2

* The curriculum design is based on the concept of foundation, breadth and depth courses so that streams for different specializations can be created within each discipline.

Foundation Courses:

The foundation courses are the courses that all students in a given discipline of engineering must take. These courses provide students with the fundamental concepts and tools to pursue their studies at the higher level.

Breadth Courses:

The breadth courses introduce students to different specialties in the given discipline of engineering early in their studies.

Depth Courses:

The depth courses offer specialization within each engineering discipline. All depth courses must integrate a substantial design component.

10.6.4 Curriculum Design of BSc Agricultural Engineering

Domain	Knowledge Area	Number of Courses	Total Credit Hour	Percent (Overall)
Engineering	Engineering Foundation	9	23	**65.44**
	Core **Breadth** of Engg discipline	9	24	
	Core **Depth** of Engg discipline	8	24	
	Multi- disciplinary engineering courses (MDE)	3	6	
	Computer and Information Science	2	6	
	Final Year Design Project (FYDP)	2	6	
	Sub Total	**33**	**89**	
Non-Engineering	Humanities	7	16	**34.56**
	Natural Sciences	6	18	
	Management Sciences	2	4	
	Flexible Engineering/Non-Engineering Courses	4	9	
	Sub Total	**20**	**47**	
	Total	53	136	**136**

11 Scheme of Study for Bachelor of Agricultural Engineering

Year-1										
First Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	SEE-101	Engineering Drawing & Graphics	Engineering	Engineering Foundation		WK3	2(1-1)	1	1	2
2	CSC-101	Information and Communication Technologies (ICT)	General Education/Non-Engineering	Humanities	Social Science	WK2	2(1-1)	1	1	2
3	SEE-103	Surveying and leveling	Engineering	Engineering Foundation		WK3	3(2-1)	2	1	3
4	MAT-101	Calculus and Analytical Geometry	Non-Engineering	Natural Sciences	Mathematics	WK2	3(3-0)	3	0	3
5	ENG-101	Functional English	Non-Engineering	Humanities	English	WK7	3(3-0)	3	0	3
6	ISL-101	Islamic Studies and Ethics	Non-Engineering	Humanities	Culture	WK7	2(2-0)	2	0	2
7	CHM-101	Fundamentals of Chemistry (for the students having ICS background)	Non-Engineering	Natural Sciences	Chemistry	WK1	3 (2-1)	Non-Credit Hour Course (Mandatory and Qualifying Only)		
8	ARAB-151	Translation of the Holy Quran I	Non-Engineering	Humanities	Culture	WK7	0 (1-0)	Non-Credit Hour Course**		
Total								**12**	**3**	**15**

Year-1										
Second Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-102	Fluid Mechanics	Engineering	Engineering Foundation		WK3	3(2 - 1)	2	1	3
2	FMP-102	Metallurgy and Workshop Practices	Engineering	Engineering Foundation		WK3	2(1-1)	1	1	2
3	PHY-102	Applied Physics	Non-Engineering	Natural Sciences		WK1	3(2-1)	2	1	3
4	SEE-104	Computer Aided Drawing	Engineering	Engineering Foundation		WK3	2(1-1)	1	1	2
5	AGR-101	Basic Agriculture	Non-Engineering	Natural Sciences	Agri Sciences	WK1	2(1-1)	1	1	2
6	MAT-102	Linear Algebra	Non-Engineering	Natural Sciences	Mathematics	WK2	3(3-0)	3	0	3
7	ENG-102	Technical Writing and Presentation Skills	Non-Engineering	Humanities	English	WK7	3(3-0)	3	0	3
8	ARAB-152	Translation of the Holy Quran II	Non-Engineering	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**13**	**5**	**18**

Year-2										
Third Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-201	Soil Mechanics	Engineering	Core Breadth of Engg discipline		WK4	3(2–1)	2	1	3
2	SEE-201	Engineering Mechanics	Engineering	Engineering Foundation		WK3	3(2-1)	2	1	3
3	FMP-201	Applied Thermodynamics	Engineering	Engineering Foundation		WK3	3(2-1)	2	1	3
4	FMP-203	Manufacturing Engineering	Engineering	Engineering Foundation		WK4	2(1-1)	1	1	2
5	CHM-102	Industrial Chemistry	Non-Engineering	Natural Sciences	Chemistry	WK1	3(2-1)	2	1	3
6	CSC-201	Computer Programming	Engineering	Computer and Information Science	ICT/AI/Data Sciences/ Cyber Security	WK2	3(3-0)	2	1	3
7	ARAB-251	Translation of the Holy Quran III	Non-Engineering	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**11**	**6**	**17**

Year-2										
Fourth Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-202	Open Channel Hydraulics	Engineering	Core Depth of Engg discipline		WK5	3(2-1)	2	1	3
2	SEE-202	Strength of Materials	Engineering	Core Breadth of Engg discipline		WK4	3(2-1)	2	1	3
3	SEE-204	Environmental Engineering	Engineering	Core Breadth of Engg discipline		WK4	3(2-1)	2	1	3
4	FMP-202	Instrumentation and Control	Engineering	Engineering Foundation		WK3	3(2-1)	2	1	3
5	AEN-202	Occupational Health and Safety	Engineering	MDE		WK2	2(1–1)	1	0	1
6	SES-202	Soil Science	Non-Engineering	Natural Sciences	Agri Sciences	WK1	2(1-1)	1	1	2
7	SSH-202	Ideology and Constitution of Pakistan	Non-Engineering	Humanities	Culture	WK7	2(2- 0)	2	0	2
8	ARAB-252	Translation of the Holy Quran IV	Non-Engineering	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**12**	**5**	**17**

Year-3										
Fifth Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-301	Pumps and Tubewells	Engineering	Core Breath of Engg discipline		WK6	2(1-1)	1	1	2
2	FMP-301	IC Engines and Tractors	Engineering	Core Depth of Engg discipline		WK6	3(2-1)	2	1	3
3	FMP-303	Machine Design	Engineering	Core Depth of Engg discipline		WK5	3(2-1)	2	1	3
4	SEE-301	MDE Elective-I (Wastewater Engineering)	Engg.	Multi-disciplinary engineering courses (MDE)		WK4	3(2–1)	2	1	3
5	MAT-301	Probability and statistics	Non-Engineering	Natural Sciences	Mathematics	WK2	3(3-0)	3	0	3
6	SSH-301	Civics and Community Engagement	Non-Engineering	Humanities	Social Science	WK7	2(2-0)	2	0	2
7	ARAB-351	Translation of the Holy Quran V	Non-Engineering	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**14**	**4**	**16**

Year-3										
Sixth Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-302	Engineering Hydrology	Engg.	Core Breadth of Engg discipline		WK4	3(2 – 1)	2	1	3
2	I&D-304	Irrigation Engineering	Engg.	Core Depth of Engg discipline		WK5	3(2 -1)	2	1	3
3	I&D-306	High Efficiency Irrigation Systems	Engg.	Core Breadth of Engg discipline		WK4	2(1-1)	1	1	2
4	FMP-302	Earth Moving Machinery	Engg.	Core Breadth of Engg discipline		WK4	2(1-1)	1	1	2
5	MSC-302	Management Elective-I (Engineering Project Management)	Non- Engg.	Management Science	Professional Practice	WK7	2(2-0)	2	0	2
6	MAT-304	Numerical Analysis	Non-Engineering	Natural Sciences	Mathematics	WK2	3(2-1)	2	1	3
7	SSH-302	Social Sci Elective-II (Economics for Engineers)	Non- Engg.	Humanities	Social Science	WK7	2(2-0)	2	0	2
8	ARAB-352	Translation of the Holy Quran VI	Non- Engg.	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**12**	**5**	**17**

Year-4										
Seventh Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-401	GIS & Remote Sensing	Engineering	Computer and Information Science	ICT/AI/Data Sciences/ Cyber Security	WK4	3(2-1)	2	1	3
2	SEE-401	Solid Waste Engineering	Engineering	Core Breadth of Engg discipline		WK4	3(2–1)	2	1	3
3	FMP-401	Agricultural Process Engineering	Engineering	Core Breadth of Engg discipline		WK4	3(2-1)	2	1	3
4	FMP-403	Farm Machinery and Automation	Engineering	Core Depth of Engg discipline		WK6	2(2-1)	2	1	3
5	I&D/SEE-FMP-	Engg Elective-I	Engineering	Core Breadth of Engg discipline		WK4	3(1-1)	1	1	2
6	AEN-401	Final Year Design Project (FYDP)-I	Engineering	Final Year Design Project (FYDP) Capstone	Industrial/ Innovative/ Creative Project	WK8	3(0-3)	0	3	3
7	MSC-401	Management Elective-II (Entrepreneurship)	Non-Engineering	Management Sciences	Professional Practice	WK7	2(2-0)	2	0	2
8	ARAB-451	Translation of the Holy Quran VII	Non-Engineering	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**11**	**8**	**19**

Year-4										
Eighth Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-402	Drainage Engineering	Engineering	Core Depth of Engg discipline		WK5	3(2-1)	2	1	3
2	SEE-402	Farm Structures and Control Sheds	Engineering	Core Breath of Engg discipline		WK5	3(2-1)	2	1	3
3	FMP-402	MDE Elective-II (Alternate and Renewable Energy (ARE))	Engineering	Multi-disciplinary engineering courses (MDE)		WK4	2(1–1)	1	1	2
4	I&D/SEE/ FMP-	Engg. Elective-II	Engineering	Core Depth of Engg discipline		WK4	3(2-1)	2	1	3
5	I&D/SEE/ FMP-	Engg. Elective-III	Engineering	Core Depth of Engg discipline		WK4	3(2-1)	2	1	3
6	AEN-402	Final Year Design Project (FYDP) - II	Engineering	Final Year Design Project (FYDP)/ Capstone	Industrial/ Innovative/ Creative Project	WK8	3(0-3)	0	3	3
7	ARAB-452	Translation of the Holy Quran VIII	Non-Engineering	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**9**	**8**	**17**

These are proposed engineering elective courses and the HEIs may further add or choose courses as per their program objectives and needs.

11.2 Courses for Engineering Elective Streams

11.2.1 Water Resources Engineering

- Farm Irrigation System (ID)
- Farm Water Management (ID)
- Groundwater Hydrology (Elective ID)
- Soil Dynamics (Elective ID)
- Water Resources Assessment and Management (ID)
- Soil and Water Conservation Engineering (ID)
- Irrigation Water Management Techniques (ID)

11.2.2 Farm Machinery and Power

- Boiler Engineering & Power Plants (FMP)
- Energy in Agriculture (FMP)
- Agro-Industrial Engineering (FMP)
- Precision Agriculture (FMP)
- Robotics in Agriculture (FMP)
- Design of Agricultural Machinery (FMP)
- Post-Harvest Technologies (FMP/SEE)
- Hydraulic Machinery and Automation (FMP)
- Emerging Farm Engineering Systems (FMP)
- Electronics Engineering (FMP)

11.2.3 Farm Structures and Environment

- EIA and EMS for Industries (SEE)
- Sustainable Environment (Elective SEE)
- Environmental Modelling and Simulation
- Environmental Impact Assessment (SEE)
- Cleaner Production Techniques (Elective SEE)
- Landscape Engineering (SEE)
- Quantity Survey and Cost Estimation (SEE)

11.2.4 Electives for Social Sciences

- Sociology for Engineers
- Professional Ethics
- Economics for Engineers
- Sociology
- Social Anthropology
- Understanding Psychology and Human
- Social Psychology
- Organizational Behavior
- Critical Thinking
- Philosophy
- Human Resource Development
- Culture and Society
- Engineering Law

11.2.5 Electives for Management Science

- Entrepreneurship
- Entrepreneurship and Marketing
- Engineering Project Management
- Principles of Management
- Engineering Management
- Quality Management Systems
- Textile Marketing
- Industrial Engineering and Management
- Total Quality Management
- Supply Chain Management
- Production Management

11.2.6 Courses for Computer Science

- Information and Communication Technologies (ICS)
- Artificial Intelligence
- Cyber Security
- Data Science
- Computer Programming
- Modelling and Simulation

12 Program Specific Labs

The following labs specific to engineering discipline be ensured to cover relevant knowledge domains.

- Soil Mechanics Lab
- Fluid Mechanics Lab
- Strength of Materials Lab
- Irrigation and Drainage Engineering Lab
- Farm Machinery Lab
- Machine Shop
- Thermodynamics and Energy Lab
- I.C. Engines Lab
- Instrumentation Lab
- High Efficiency CAD/CAM Lab
- Environmental Engineering Lab
- Surveying and levelling Lab
- Computer and GIS Lab
- Engineering Drawing Hall
- Engineering Mechanics Lab
- Final Year Project Exhibition Hall

13 Course Details and Teaching-Assessment Approaches

In the following sections, Course Outlines and teaching-assessment approaches are given for guidance based on a typical semester system. The instructors may adopt or adapt accordingly defining CLOs, course delivery plan, innovative teaching approaches and assessment techniques.

Year-1										
First Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	SEE-101	Engineering Drawing & Graphics	Engineering	Engineering Foundation		WK3	2(1-1)	1	1	2
2	CSC-101	Information and Communication Technologies (ICT)	General Education/Non-Engineering	Humanities	Social Science	WK2	2(1-1)	1	1	2
3	SEE-103	Surveying and leveling	Engineering	Engineering Foundation		WK3	3(2-1)	2	1	3
4	MAT-101	Calculus and Analytical Geometry	Non-Engineering	Natural Sciences	Mathematics	WK2	3(3-0)	3	0	3
5	ENG-101	Functional English	Non-Engineering	Humanities	English	WK7	3(3-0)	3	0	3
6	ISL-101	Islamic Studies and Ethics	Non-Engineering	Humanities	Culture	WK7	2(2-0)	2	0	2
7	CHM-101	Fundamentals of Chemistry (for the students having ICS background)	Non-Engineering	Natural Sciences	Chemistry	WK1	3 (2-1)	Non-Credit Hour Course (Mandatory and Qualifying Only)		
8	ARAB-151	Translation of the Holy Quran I	Non-Engineering	Humanities	Culture	WK7	0 (1-0)	Non-Credit Hour Course**		
Total								**12**	**3**	**15**

SEE-101 Engineering Drawing and Graphics 2(1-1)

Contact Hours Theory = 15 Practical = 45 Total = 60	**ENGINEERING DRAWING & GRAPHICS** **SEE-101 | 1st Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours 2(1-1)** Theory = 1.0 Practical = 1.0 Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN engineering visualization principles and projection theory and apply those principles in engineering drawing development	Cognitive	C2	PLO1	PEO1
CLO2	EFFECTIVELY read, understand, and reproduce engineering drawing	Affective	A2	PLO9	PEO2
CLO3	CONSTRUCT the orthographic projections and sectional views of different mechanical parts and individual ideas of product.	Psychomotor	P4	PLO3	PEO3

Course Outline:

1. Introduction to engineering drawing, various types of lines,
2. basic geometrical constructions, conic sections,
3. theory of orthographic projection, dimensioning and lettering,
4. Introduction to tolerance,
5. projections off points, projections of straight lines,
6. Projections of planes and solids in simple position, sectioning of solids,
7. Isometric projections, development of surfaces

Practical:

Introduction to drawing instruments and their use, various scales, practice of orthographic projection missing lines in orthographic projection, drawing three views of different objects, Practice of Dimensioning and Lettering, Practice of Sectioning, Conversion of orthographic projection into isometric view, Creating drawings of Engineering Fasteners like Rivets, Cotters Joints, threads etc.

Teaching Methodology (Proposed as applicable)

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. French, T. E. and Vierch, C. J. (2000). A Manual of Engineering Drawing. McGraw Hill Book Co. New York.
2. Parkinson A.C. 1998. A First year Engineering Drawing, Sir Isaac Pitman and Sons Ltd., England.
3. James, H. Earle. 1992. Engineering Design Graphics, Addison-Wisley Publishing Co. Reoding, Massachusetts.

CSC-101 Information and Communication Technologies (ICT) 3(2-1)

Contact Hours	**INFORMATION AND COMMUNICATION TECHNOLOGIES**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**CSC-101 | 1st Semester** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the basic computer system, its operation and applications in various fields especially in education and engineering disciplines.	Cognitive	C2	PLO1	PEO1
CLO2	DESCRIBE the data processing and data security in computer, internet and web applications and networking concepts and database management.	Cognitive	C2	PLO10	PEO2
CLO3	FOLLOW instructions and perform the embedded systems with applications and programming languages to use for system developments and problem solving.	Psychomotor	P3	PLO5	PEO2

Course Outline: Introducing Computer Systems: Basic Definitions

- Computer and Communication Technology
- The applications of ICT - particularly for Engineers

Basic operations and components of a generic computer system

- Basic operations: Input, Processing, Output, Storage Basic components: Hardware, Software, Data, Users
- Types of storage devices

Processing Data

- Transforming data into information
- How computers represent and process data
- Processing Devices
- CPU architectures

The Internet

- The Internet and the World Wide Web- browsers, HTML
- URLs/ How DNS works
- Email and other programs

Introduction to Embedded Systems

- What is an Embedded System
- Applications
- Components
- Programming Languages
- Popular Development Platforms

Networking Basics

- Uses of networks
- Common types of networks (LAN, WAN, MAN etc.)
- Introduction to OSI Model
- Future of Networks

Database Management

- Hierarchy of Data
- Maintaining Data
- Database Management Systems

Exposure to ICT Tools and Blogs (Student Assignment)

Protecting your privacy, your computer and your data

- Basic Security Concepts
- Threats to users
- Threats to hardware
- Threats to Data

ICT in Education

Future Trends in ICT

Final Presentations

Tools / Software Requirement
Microsoft Office, Windows, Virtual Box, Netbeans

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Projects, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. "Introduction to Computers", Peter Norton, 7th Edition, 2013, McGraw-Hill.
2. "Computing Essentials", Timothy O'Leary and Linda O'Leary, 2010, McGraw-Hill.
3. Using Information Technology: A Practical Introduction to Computers & Communications", Williams Sawyer, 6th Edition, 2005, McGraw-Hill.
4. "Discovering Computers, Complete: Your Interactive Guide to the Digital World. Cengage Learning" Shelly GB, Vermaat ME, 2012 Ed.

SEE-103 **Surveying and Leveling** **3(2-1)**

Contact Hours	**SURVEYING AND LEVELLING**	**Credit Hours**
Theory = 30	**SEE-103 | 2nd Semester**	**3(2-1)**
Practical = 45	**(B.Sc. Agricultural Engineering)**	Theory = 2.0
Total = 75		Practical = 1.0
		Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN various principles and techniques of basic Survey &levelling	Cognitive	C1&C2	PLO1	PEO1
CLO2	APPLY various techniques to plot survey maps, contour and profile maps using measured data from conventional and modern tools like Total station, Differential GPS etc.	Cognitive	C3	PLO2	PEO1
CLO3	OPERATE various survey and levelling equipment for measurements with required accuracy in field	Psychomotor	P3	PLO3	PEO1

Course Outlines:

1. Introduction to Surveying and Leveling
2. Surveying instruments.
    a. Chains, Tapes, Steel Bands, their Types and Uses
    b. Chain Surveying: Ranging and chaining of survey Lines.
    c. Fieldwork and plotting of chain survey.

2. Compass Surveying: Prismatic Compass and Surveyor Compass, Uses, Bearing, Local Attraction, Fieldwork and Plotting
    a. Plane Table Surveying:
    b. Parts and Accessories,
    c. Methods of Surveying, Two Point and Three Point Problems

3.Leveling: General Principle,
    a. Types of Levels and their temporary and Permanent
    b. Adjustments, Methods of Leveling, Reduction of Level, Precise Leveling and Trigonometric Leveling

4. Theodolite: Types and uses of Theodolites, Temporary and Permanent Adjustments, Measurement of Horizontal and Vertical angles
5. Tachometrical Surveying: Methods of Tachometric Surveying.
    a. Fieldwork and computations.
    b. Traversing: Traversing with Prismatic Compass, Theodolite and Plane Table,
    c. Computations and Adjustments of Traverse, Transformation of Co-ordinates
    d. Calculation of Areas and Volumes: Earth work calculation, D.M.D method, Simpson rule and Trapezoidal rule
6. Total Station and GPS

Practical:

- Introduction to measuring instruments and practice on measurement of distances.
- Chain Surveying and plotting.
- Compass Traversing
- Plane Tabling by methods of radiations and intersections.
- Two Points Problem
- Three Points Problem
- Introduction to measuring instruments and practice on measurement of distances.
- Level adjustments by Two-Peg method.
- Profile and Cross-Sectioning
- Theodolite Traversing

Teaching Methodology (Proposed as applicable))

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Brinker, A.C. and Taylor, W.C. 2002. Elementary Surveying. International Text Book Co. Scranton, Pennsylvania, USA.
2. Ramsay, J.P. Wilson. 2000. Land Surveying. Macdonald and Evans Ltd. Estover, Plymouth PL 6 7PZ.
3. Clark, David. 1989. Plane and Geodetic Surveying for Engineers Vol. I. Constable and Co. Ltd. London, England.

MAT-101 Calculus and Analytical Geometry 3(3-0)

Contact Hours	**CALCULUS AND ANALYTICAL GEOMETRY**	**Credit Hours**
Theory = 45	**MAT-101 | 1st Semester**	**3(3-0)**
Practical = 0	**(B.Sc. Agricultural Engineering)**	Theory = 3.0
Total = 45		Practical = 0.0
		Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN the knowledge related to the fundamentals of calculus and analytical geometry.	Cognitive	C2	PLO1	PEO1
CLO2	APPLY the differentiation integration in solving analytical problems	Cognitive	C3	PLO3	PEO1
CLO3	DEMONSTRATE the use of acquired knowledge to solve problems of practical nature	Psychomotor	P2	PLO2	PEO2

Area Scope:

a. To develop a clear understanding of fundamental concepts of single variable calculus
b. To apply concepts of differentiation and integration to solve complex engineering problems

Course Outline

Analytical Geometry:

c. Review of vectors, scalars and vector products.
d. Three-dimensional coordinate system and equation of straight line and plane

Functions Limit and Continuity:

e. Review of functions and graphs,
f. Limits & Continuity,
g. Techniques of Finding Limits,

h. Discontinuity,
i. Limits of Sine and Cosine and Exponential Functions

Differentiation:

a. Introduction to Derivatives
b. Examples of Derivatives
c. Derivative as Rate of Change
d. Derivative's Rules
e. Implicit Differentiation
f. Higher order derivatives
g. Leibnitz Theorem

Applications of Derivatives:

a. Applications of Derivatives
b. Monotonic functions
c. Optimization problems
d. Relative and Absolute extrema
e. First and second derivative tests
f. Point of inflection
g. Concavity
h. Curvature
i. Indeterminate Forms and L' Hospital rule
j. Differentials

Integration:

a. Integrals and Properties of Integrals
b. Techniques of Integration
c. Integration by Parts
d. Definite Integrals
e. Integration of Trigonometric
f. Exponential and Inverse Functions
g. Integration by Partial Fractions
h. Reduction Rules

Applications of Integration:

a. Applications of Integration
b. Area under the curve
c. Area between curves
d. Solids of Revolution
e. Volume of Solids of revolution by disk
f. washer, Cylindrical shell & Cross Section Methods
g. Center of Pressure and Depth of Center of Pressure
h. Center of mass
i. Arc length

Improper Integrals:

a. Improper Integrall
b. Integrals and Singularities
c. Convergence of improper integrals

Infinite Sequence and Series:

a. Sequence and Infinite Series
b. Convergence and Divergence of sequences and series
c. Positive Term Series
d. Integral Test
e. Basic Comparison Test
f. Limit Comparison Test
g. Ratio and Root tests
h. Alternating series
i. Absolute and Conditional Convergence

Power and Taylor Series:

a. Power series
b. Maclaurin and Taylor Series and its Applications

Teaching Methodology (Proposed as applicable))

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion and report writing

Assessment

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Thomas' Calculus by George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass, Pearson, USA.
2. Swokowski, Onlinick & Pence: Calculus
3. Robert T. Smith & Roland B. Minton: Calculus
4. Calculus: Early Transcendentals by James Stewart. Brooks/Cole USA

ENG-101 FUNCTIONAL ENGLISH 2(2-0)

Contact Hours	**FUNCTIONAL ENGLISH**	**Credit Hours**
Theory = 45	**ENG-101 | 1st Semester**	**3(3-0)**
Practical = 0	**(B.Sc. Agricultural Engineering)**	Theory = 3.0
Total = 45		Practical = 0.0
		Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	KNOW English correctly in speaking and writing skills.	Cognitive	C2	PLO6	PEO2
CLO2	APPLY different writing and active reading strategies to comprehend texts.	Affective	A2	PLO10	PEO2
CLO3	INTERPRET and TRANSLATE the vocabulary and skills to use English in professional Life.	Cognitive	C2	PLO12	PEO3

Area Scope:

The knowledge units in this area collectively encompass the following:

- Follow English vocabulary and skills to use it in professional life.
- Identify common errors usually made by the Learners of English as second language
- Practice English correctly in speaking and writing

Course Outlines:

- Public Speaking, The Art of Creating a Power Point Presentation.
- Interacting with the Opposite Gender , Classroom Etiquettes and Teachers' Expectations
- Articles, Prepositions.
- Homophones, Punctuation
- Tenses in English Grammar, Formal Letter Writing
- Summary writing
- Organizing and planning your writing
- Sensory Perception in writing.
- Critical thinking
- Final Term Project

Teaching Methodology (Proposed as applicable))

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- P. C. Wren & H. Martin "High School English Grammar & Composition".
- Colin W. Davis & Andrew J. Watts New Expressway For English 1 (New Edition)
- Hert A. Murphy & Herbert William Hildebrandt. Effective Business Communications
- Diana Hacker. A Writer's Reference
- Sadat Ali Shah. Exploring The World Of English
- A. J. Thomson and A. V. Martinet. Practical English Grammar,"University Physics", 13th Edition

ISL-101 Islamic Studies and Ethics 2(2-0)

Contact Hours	ISLAMIC STUDIES AND ETHICS	Credit Hours
Theory = 30 Practical = 0 Total = 30	**ISL-101 | 1st Semester** **(B.Sc. Agricultural Engineering)**	**2(2-0)** Theory = 2.0 Practical = 0.0 Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the basic beliefs of Islam, Islamic civilization and moral values through the texts of QURAN and HADITH.	Cognitive	A3	PLO6	PEO3
CLO2	STATE the relevance of Islamic teachings to social, political and economic development of modern age	Cognitive & Affective	C1&A4	PLO8	PEO3
CLO3	DEMONSTRATE the understanding of fundamental human rights and relation with non-muslims	Psychomotor	P1, A3 & A4	PLO10	PEO2

Course Description:
The Islam is a religion of peace and harmony for all humans based on knowledge and guidance in the Holy Quran. The basic teachings of Islam are comprehensive, practicable and universal. Therefore, this course briefly presents the vision of life and applied aspects of ethical system.

Area Scope:

- To enhance understanding of Islamic Culture and Civilization
- To understand values and social system in Islam
- To improve students' ethical and professional skill and critical thinking

Course Outline:

1. Islam – Religion of Peace and Harmony

- Basic Concepts – Islam, Quran and Hadith
- Faith and Religious Life
- Selected Verses of Surah Al-Baqara Related to Faith (Verse No-284-286)
- Selected Verses of Surah Al-Mumanoon Related to Characteristics of Faithful (Verse No-1-11)

2. Islamic Culture and Civilization

- Basic Concepts and of Characteristics of Islamic Culture and Civilization
- Education System of Islam
- Political System of Islam – Dynamics, Sovereignty and Institutions
- Economic System of Islam – Principles, Riba, Trade and Commerce
- Acceptance of Other Religions – Interfaith Harmony
- Foreign Policy

3. Social System of Islam

- Basic Concepts of Social System in Islam
- Elements of Family and their Rights - Parents, Women, Husband & Wife, Children
- Inheritance – Rights and Laws
- Social Rights – Neighbors, Relatives and Society
- Equality and Brotherhood
  - Selected Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- Concept of Welfare State – Period of Khilafat-e-Rashida

4. Professional Ethics and Morality

- Basic Concepts - Islam and Ethics
  - Selected Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)
- Profession and Professionalism in Islam
- Characteristics of a Professional
  - Truthfulness, Honesty, Sincerity, Patience, Gratitude, Meditation and Research
- Role for Human Safety and Environment
- Time Management
- Prophet Muhammad (PBUH) – Role Model
- Selected Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
- Selected Versus of Surah Al-Ihzab Related to Adab Al-Nabi (Verse No. 6, 21, 40, 56, 57, 58)

5. Islam and Science

- Islam and Science
- Role of Muslims in Science and Education
- Critical Thinking and Innovation
- Selected Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- Selected Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No1,14)

Note: All topics should be taught/covered in the light of relevant Verses from Holy Quran and Ahadiths.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Al-Qur'ān **القرآن (**selected text).
2. Sayyid Tāhir Rasūl Qādri **دروس قرآن 52** (Karachi: Islamic Research Academy, 7th ed., 2017).
3. Sayyid Hasan-uddin Ahmad**, تعلیمات قرآنی** 2-vols., (Karachi: Jasarat Publications, 1998).
4. Muhammad Shafī',**معارف القرآن** (Karachi: Dar-ul-Isha'at, 2000).
5. Sayyid Abu'l A'lā Mawdūdī, 6 **تفہیم القرآن**vols., (Lahore: Islamic Publications, 1998). [Preambles of all (114) chapters.]
6. Amin Ahsan Islahi, **تدبرالقرآن** (Lahore: Farān Publications, 2005).
7. Khawaja Abdul Waheed, **موضوعات قرآن وانسانی زندگی** (Islamabad: Islamic Research Institute, 3rd ed., 1997).
8. Khurram Murad, **رب کا پیغام** (Lahore: Manshūrat, Mansoora, 2000)
9. Hameed ullah Muhammad, "Emergence of Islam", Islamic Research Institute (IRI), Islamabad
10. Hameed ullah Muhammad, "Muslim Conduct of State" Sh Muhammad Ashraf, Kashmir Bazar, India (Latest Edition)
11. Hameed ullah Muhammad, "Introduction to Islam" Compiled by The CSS Point, www.thecsspoint.com
12. Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan, (Latest Edition).
13. H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989).
14. Islamic Education by A. S. Bukhari & M. D Zafar, Latest Edition.
15. Muslim's character by M. Al-Ghazali, Latest Edition

ARAB-151 Translation of the Holy Quran I (1-0)

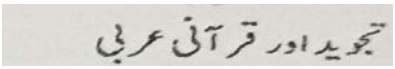
Contact Hours	**TRANSLATION OF THE HOLY QURAN I**	**Credit Hours**
Theory = 15		**1(1-0)**
Practical = 0	**ARAB-151 | 1st Semester**	Theory = 1.0
Total = 15	**(B.Sc. Agricultural Engineering)**	Practical = 0.0
		Total = 1.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the basic beliefs of Islam, through the translation of Arabic texts of QURAN.	Cognitive	C1	PLO8 & PLO12	PEO3
CLO2	DISCUSS the Islamic civilization and culture, human rights in Islam, the lawful in Islamic sharia through the translation	Cognitive	C2	PLO6 & PLO12	PEO3

	of Arabic texts of QURAN				



CHM-101 Fundamentals of Chemistry 3(2-1)

Contact Hours	**Fundamentals of Chemistry (for students having ICS background)**	**Credit Hours**
Theory = 15	**CHM-101 | 1st Semester**	**1(1-0)**
Practical = 0	**(B.Sc. Agricultural Engineering)**	Theory = 1.0
Total = 15		Practical = 0.0
		Total = 1.0

Course Description

This is an introductory course of chemistry designed for BSc Agricultural Engineering students with an ICS background during intermediate studies (ICS). The course aims to cover the chemistry subject deficiency of the students and to enable their smooth and efficient learning during the degree program. The course includes the basic concepts of the structure, properties, and interactions of matter and energy are studied both qualitatively and quantitatively. The course also presents the fundamental principles of chemistry, particularly regarding acid-base and redox chemistry, the electronic structure of atoms and molecules, properties of liquids, gases, solids and their solutions, phase changes, and thermochemistry. The associated laboratory exercises emphasize proper experimental techniques, data analysis, safety and writing skills.

Course Learning Outcomes (CLOs)

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

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	UNDERSTAND the basic terminologies of chemistry	Cognitive	C2	PLO1	PEO1
CLO2	EVALUATE chemical properties of the states of matter and describe how matter and energy interact	Cognitive	C4	PLO2	PEO1
CLO3	EXPLAIN the key concepts, models and experiments leading to the development of atomic theory	Cognitive	C3	PLO6	PEO2
CLO4	PERFORM the practical work in laboratory to take qualitative/quantitative results	Psychomotor	P4	PLO9	PEO3

Course Outline

Physical chemistry

- Atomic structure
- Atoms, molecules and stoichiometry
- Chemical bonding
- States of Matter
- Chemical energetics
- Electrochemistry

Inorganic chemistry

- The Periodic Table: chemical periodicity
- Group 2 - Group 17
- Nitrogen and sulphur
- Chemistry of transition elements

Organic chemistry

- An introduction to AS Level organic chemistry
- Hydrocarbons
- Halogen, Hydroxy, Carbonyl compounds
- Carboxylic acids and derivatives
- Nitrogen compounds
- Polymerisation
- Organic synthesis
- An introduction to A Level organic chemistry

Physical chemistry

- Chemical energetics
- Electrochemistry
- Equilibria
- Reaction kinetics

4.2 Practical

1. Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations
2. Analysis of four ions (two anions and two cations) from mixture of salts
3. Determination of the percent composition of liquid solutions viscometrically
4. Determination of percent composition of liquid solutions by refractive index measurements
5. Determination of molecular weight of a compound by lowering of freezing point (cryoscopic method)
6. Determination of the partition coefficient of a substance between two immiscible liquids
7. Determination of activation energy for the acid catalyzed hydrolysis of ethyl acetate.

4.3 Recommended Books

1. Huheey, J. E., Keiter, E. A. and Keiter, R. L., “Inorganic Chemistry: Principles of Structure and Reactivity”, 4th Ed., Harper and Row, New York, 2001.
2. Agarwal, O.P., A. Agarwal, 2001. Engineering Chemistry. Khana Publishers, India.
3. Bansal, R. K., “Organic Reaction Mechanisms”, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. Laidler K.J., John H.M. and Bryan C.S. “Physical Chemistry” 4th ed., Houghton Mifflin Publishing Company Inc.(2003).

Year-1										
Second Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-102	Fluid Mechanics	Engineering	Engineering Foundation		WK3	3(2 - 1)	2	1	3
2	FMP-102	Metallurgy and Workshop Practices	Engineering	Engineering Foundation		WK3	2(1-1)	1	1	2
3	PHY-102	Applied Physics	Non-Engineering	Natural Sciences		WK1	3(2-1)	2	1	3
4	SEE-104	Computer Aided Drawing	Engineering	Engineering Foundation		WK3	2(1-1)	1	1	2
5	AGR-101	Basic Agriculture	Non-Engineering	Natural Sciences	Agri Sciences	WK1	2(1-1)	1	1	2
6	MAT-102	Linear Algebra	Non-Engineering	Natural Sciences	Mathematics	WK2	3(3-0)	3	0	3
7	ENG-102	Technical Writing and Presentation Skills	Non-Engineering	Humanities	English	WK7	3(3-0)	3	0	3
8	ARAB-152	Translation of the Holy Quran II	Non-Engineering	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**13**	**5**	**18**

I&D-102 **Fluid Mechanics** **3(2-1)**

Contact Hours Theory = 30 Practical = 45 Total = 75	**FLUID MECHANICS** **I&D-102 | 2nd Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	**DESCRIBE** and **EXPLAIN** the basic concepts of the fluid statics, kinematics and hydrodynamics	Cognitive	C2	PLO1	PEO1
CLO2	**APPLY** relevant equations for solving different engineering problems based on fluid statics and dynamics	Cognitive	C3	PLO3	PEO1
CLO3	**ANALYZE** the equilibrium of floating bodies and fluid flow properties by considering similitude, dimensionless numbers etc.	Cognitive	C4	PLO2	PEO1
CLO4	**CONDUCT** and **EXECUTE** different experiments of fluid dynamics and discharge measurements	Psychomotor	P4	PLO9	PEO1

Course Outline:

1) Introduction:
   a) Definition and branches of fluid mechanics,
   b) Distinction between solid and fluids.
2) Properties of fluids
   a) density, viscosity, surface tension, specific weight, specific gravity, etc.,
   b) bulk modules of elasticity, compressibility of fluids
3) Fluid Statics:
   a) Pressure variations in fluid, pressure measuring devices, gauges and manometers,
   b) buoyancy and stability of submerged and floating bodies,
   c) forces on plane and curved surfaces, center of pressure.
4) Fluid Kinematics:
   a) Continuity Equation
   b) Types of flow, dimensions of flow, streamlines, path lines,
   c) flow patterns for different references, continuity equation,
   d) source flow, sink flow, flow nets, uses and limitations of flownet.
5) Fluid Flow Measurements:
   a) Orifices, weirs, notches and venturmeter,

b) pitot tube, coefficient of contraction,
c) velocity and discharge, derivation of their discharge formulae,
d) calibration and their applications.

6) Energy Consideration in Steady Flow:
   a) General equations of steady flow, heads,
   b) Bernoulli's equation and its practical applications,
   c) hydraulic and energy grade lines, power consideration in fluid flow,
   d) Cavitation, head losses, solution of flow problems.
7)) Momentum and Forces in Fluid Flow:
   a) Impulse-momentum principle and application,
   b) force exerted on a stationary and moving bodies (flat and curved),
   c) relation between absolute and relative velocities, reaction of jet, jet propulsion
8)) Similitude and dimensional analysis:
   a) Geometric, kinematic, dynamic similarity,
   b) dimensionless numbers like Reynold Number,
   c) Froude number etc., and their application,
9) Steady incompressible flow in pressure conduits:
   a) Laminar and turbulent flow in circular pipes,
   b) major and minor energy losses in pipes,
   c) branching pipes, pipes in series, pipes in parallel and pipe network analysis
10) Turbines: Definition,
   a) types of turbines, suitability of turbines,
   b) components of turbines,

Practical:

- Demonstration of various parts of hydraulic bench
- Measurement of metacentric height
- Determination of center of pressure
- Experimental study of laminar and turbulent flow
- Calibration of Venturimeter
- Calibration of rectangular and triangular notch
- Verification of Bernoulli's theorem
- Measurement of head loss through pipes
- Performance evaluation of turbines

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Recommended Books:

1. Cengel, Y.A., and J. Cimbala, 2013. Fluid Mechanics Fundamentals and Applications, 3rd Edition, ISBN-13: 978-0073380322

2. Frank White, 2016. Fluid Mechanics, 8th edition, McGraw-Hill Series
3. Franzini, J.B., and E.J. Finnemore. 2001. Fluid Mechanics with Engineering Application, 10th Edition, McGraw Hill Book Co. Singapore.
4. Jain, A.K. 1990. Fluid Mechanics: A Text Book for Engineering Students. Khana Publishers, New Delhi, India.
5. Streeter, V.L. 1988. Fluid Mechanics. McGraw Hill Inc., New York.

FMP-102 Metallurgy and Workshop Practices 2(1-1)

Contact Hours	**Metallurgy and Workshop Practices**	**Credit Hours 2(1-1)**
Theory = 15 Practical = 45 Total = 60	**FMP-102 | 2nd Semester** **(B.Sc. Agricultural Engineering)**	Theory = 1.0 Practical = 1.0 Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	CHARACTERIZATION of common engineering materials used in mechanical workshops	Cognitive	C1	PLO1	PEO1
CLO2	EXPLAIN the heat treatment theory of iron and steel and the properties of manufacturing materials	Cognitive	C2	PLO1	PEO1
CLO3	**PERFORM** the experiments related to workshop machine tool and welding process	Psychomotor	P2	PLO9	PEO3

Course Outlines:

1. **Introduction**
    a. Production and properties of common engineering materials:
    b. Properties of ferrous metals and non-ferrous metals
    c. Manufacturing processes of Iron and steel
2. **Non-metallic materials**
    a. Composition, properties and usage
    b. Plastics and rubber,
    c. Fiber glass and composite materials
3. **Alloy steel and Irons**
    a. Effect of alloying elements,
    b. AISI/SAE alloy steel and their identification,
    c. corrosion resistant steel, steel for high temperature services,

d. Alloy steel.

4. **Non-ferrous metals**
    a. Properties and usage
    b. Copper, aluminium, zinc, tin, nickel, and lead.
    c. Non- ferrous alloys, copper alloys. Aluminium alloys,
    d. Zinc base alloys, nickel base alloys.
    e. Lead-tin alloys, iron-carbon equilibrium diagram
5. **Heat treatment**
    a. Heat treatment theory and process
    b. Heat treatment of steel
    c. Heat treatment equipment
6. **Foundry**
    a. Definition, importance, advantages and disadvantages of foundry,
    b. Casting, hand moulding tools, characteristics of moulding sand, foundry cores,
    c. Properties of core and, crucibles, handling and care,
    d. Copula furnace, construction, zone of copula and its advantages.
7. **Safety and First Aid**
    a. Safety in the machine shop,
    b. Mechanical and other accidents,
    c. Safety devices, safety methods, first aid equipment and methods
    d. Care in the workshop
8. **Workshop Machine Tools**
    a. Lathe (Conventional and CNC)
    b. Milling, Shaper and Planner
    c. Drilling, Bending, Cutting
9. **Welding**:
    a. Definition, types of welding process,
    b. Survey of welding equipment.
    c. Arc welding; welding materials
    d. Inspection and testing of welded joints.
    e. Gas welding

Practical:

1. Safety and first aid in the workshop related to electrical, mechanical and other accidents. Safety in the use of hand tools.
2. Identification of tools and machines in the workshop.
3. Identification of different metals by spark tests and advance methods.
4. Demonstration of different heat treatment processes.
5. Practice of arc welding.
6. Practice of gas welding.
7. Visits to local foundries.
8. Lecture by invited guest speaker

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg

disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Recommended Books:

1. Seetharaman, S. ed., 2005. Fundamentals of metallurgy. Elsevier
2. Chapman, W.A.J. 2004. Workshop Technology Part-I and II. Viva Books Private Ltd., India.
3. Rao. P.N. 2002. Manufacturing Technology: metal cutting and machine tools. Tata McGraw-Hill Co. Ltd. New Delhi, India
4. Ostwald, P. H. and J. Munoz. 2002. Manufacturing Processes and systems. 9th edition John Wiley and Sons, New York. USA.
5. Havey, D. Miner. 1999. Exploring Pattern Making and Foundry. The MacMillan Co. N.Y., USA.

PHY-102 APPLIED PHYSICS 3(2-1)

Contact Hours Theory = 30 Practical = 45 Total = 75	**APPLIED PHYSICS** **PHY-101 | 2nd Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours** **3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)
Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DEFINE the basic terminologies related to applied physics	Cognitive	C2	PLO1	PEO1
CLO2	EXPLAIN the fundamental laws of physics relevant to the engineering sciences.	Cognitive	C3	PLO1 &PLO9	PEO1
CLO1	IMPLEMENT knowledge of basic physical laws to solve various problems of applied nature	Psychomotor	P3	PLO2	PEO2
CLO3	DEMONSTRATE working principles of different science domains such as mechanics and thermodynamics using the laws of physics.	Psychomotor	P4	PLO5	PEO2

Area Scope:
The knowledge units in this area collectively encompass the following:

Course Outline:
Vectors:

Review of vectors, Ordinary Differentiation of Vector, Gradient of Scalar field, Divergence and Curl of Vector Field. Line, surface and volume integrals with their applications.

Mechanics:

Newton Laws and their Applications(Simple Accelerometer, Banked Curve and Rotor), Frictional Forces and determination of Co-efficient of Friction, Work-Energy Theorem, applications of law of Conservation of Energy, Angular Momentum, Centre of Mass of two-particles, Many-particles and Solid Object.

Thermodynamics:

Laws of thermodynamics and Heat Transfer Mechanisms, Heat and Work, Kinetic Theory of gases, Ideal gases, Mean Free path, distribution of molecular speeds, Change in Entropy and Irreversible processes.

Electricity & Magnetism:

Electric field due to Discrete and Continuous Charge Distributions, Electrostatic Potential of discrete and Continuous charges, Gauss's Law and its Applications, Lorentz Force and Hall Effect, Ampere's Law, Magnetic Field due to current element (Circular Current Loop and Solenoid).

Waves & Oscillations:

Types of Waves and Superposition Principle, Wave Speed on a stretched string, Wave equation, Energy & Power of a Wave, Principle of Superposition and Standing Waves. Simple Harmonic oscillations. Forced & damped oscillations. **Atomic and Nuclear Physics:**

Planck's explanations of Black Body Radiation, Photoelectric Effect, Compton Effect, De-Broglie Hypothesis, X-rays and Moseley's Law, Atomic Nucleus and Properties of Nucleus, Radioactive Decay and Radioactive Dating.

Soil Physics:

Thermal and Physical properties of Soil; Factor affecting; heat flow equations, Transport of gases and water vapors through soil, Transport of inert, non-adsorbing and adsorbing chemicals in soil, Volatile organic compounds transport in soil.

Practical

- Construction of wiring systems fuses, switches of various types insulators
- Circuits design and drawing of a typical farm electrical system.
- Selection of motor for various farm equipment such as forage cutter, feed-grinders, and shop tools.
- Practice on repair and adjustment of electric motors, switches, fuses, transmission wiring controls
- Study of 3 phase induction motor
- Study of star and delta connections
- Study of semi-conductor, triode, diode valve and transistors.
- Use of AVO meter, CRO, planimeter
- Fabrication of full wave rectifier and inductance study of its wave-shape.
- Measurement of self-inductance and mutual inductance

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing.

Assessment:
Mid-semester exam, report writing/presentation, assignments, project report, quizzes, end-semester exam

Suggested Books:

1. Halliday, Resnick and Walker, "Fundamentals of Physics" 10th Edition Extended
2. Hugh D. Young and R.A. Freedman, University Physics. 12th Edition
3. Raymond A Serway and John W. Jawett, Jr. Physics for Scientists and Engineers with modern Physics, 09th Edition.
4. G. B. Thomas, R. L. Finney, "Calculus and Analytic Geometry", 13th Edition.
5. Hillel, D. 1998. Environmental Soil Physics. Elsevier Academic Press, San Diego, CA, USA.
6. Hillel, D. 2004. Introduction to Environmental Soil Physics. Elsevier Academic Press, San Diego, CA, USA.

SEE-104 **Computer Aided Drawing** **3(2-1)**

Contact Hours Theory = 15 Practical = 45 Total = 60	**Computer Aided Drawing** **SEE-104 | 2nd Semester.** **(B.Sc. Agricultural Engineering)**	**Credit Hours 2(1-1)** Theory = 1.0 Practical = 1.0 Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN engineering visualization principles and projection theory and apply those principles	Cognitive	C2	PLO1	PEO1
CLO2	EFFECTIVELY read, understand, and reproduce engineering design	Psychomotor	P4	PLO9	PEO2
CLO3	CONSTRUCT the orthographic projections and sectional views of different mechanical parts and individual ideas of product.	Psychomotor	P4	PLO4	PEO3

Course Outline:

Threaded fasteners, keys, springs, Gears and Cams. Welding and Riveting. Electric, Plumbing and Architectural Drawings and Electronic drafting. Presenting data: Charts and graphs. Computers, computer graphics, and Computer Aided Drawing. Piping. Structural Drawings. Maps and Topography.

Practical:
Drawing and working problems in AutoCAD mechanical power pack package.

RECOMMENDED BOOKS

1. Introduction Engineering Drawing, by A.C. Parkinson. Pintman & Sons
2. Engineering Drawing and Graphics Technology, By T.E. French, C.J. Vierck and R.T. Foster. McGraw-Hill Illustrated AutoCAD, BPP Publications, India
3. Frey, D. (1999). AutoCAD 2000, 1st edition. BPB Publications, New Delhi.

AGR-101 Basic Agriculture 2(1-1)

Contact Hours Theory = 15 Practical = 45 Total = 60	**BASIC AGRICULTURE** **AGR-101 | 1st Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 2(1-1)** Theory = 1.0 Practical = 1.0 Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the basics of agriculture.	Cognitive	C1	PLO6	PEO1
CLO2	DESCRIBE the crop production technology	Cognitive	C2	PLO4	PEO1
CLO3	ANALYZE classical agriculture, crop production, seed technology, farming systems and tillage practices	Psychomotor	P1	PLO2	PEO2

Course Outline:

Introduction

Introduction to the Engineering Profession and its Fields of Specialization with particular emphasis on Agricultural Engineering.

Crop Production

Major crops of Pakistan, Factors affecting crop production and distribution. Requirements for agricultural development. Classification of field crops based on agronomic use, special purpose and other basis.

Seed Technology

Role of seed in crop production. Concept of seed technology. Seed Structure and growth, Dormancy, Seed Production and its quality, Seed Processing and Seed Storage.

Farming Systems and Tillage Practices

Crop rotation. Definition and computation of cropping intensity. Farming systems and its kinds. Objectives of tillage. Effect of tillage on soil conditions, plant diseases and insects.

Dry Land Farming

Introduction, Importance, Rainfall pattern, Barani cultivation practices, Barani Agro-ecological zones, Problems and constraints of dry land, Dry land improvement, Dry land management, Barani cropping system

Land Resources and Management

Soil zones and Soil resources of Pakistan. Sustainability of land resources. Managing soil resources

Agro-Meteorology

Introduction, Weather and climate, Climatic components, Classification of climates, Climatic factors and crop production

Agro-Ecology

Introduction, Agro-ecological Features of Pakistan, Agro-ecological zones, Agro-ecology of Punjab

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Practical

1. Land measuring units (Conventional and metric systems).
2. Identification of various soil types;
3. Demonstration of various irrigation methods;
4. Identification of various crops and their seeds w.r.t food value;
5. Demonstration of improved sowing methods;
6. Visits to grain storage facilities and progressive farms;
7. Raising nursery for transplanting seedlings of non-traditional / regional crops;
8. Study of medicinal crops and organic farming.

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Nazir, S. (1994). Crop Production. National Book Foundation, Islamabad.
- Martin, J. H., W. H. Leonard and D. L. Stamp. (1990). Principles of Field Crop Production, 3rd edition. Macmillan Co. Inc New York.

MAT-102 Linear Algebra 3(3-0)

Contact Hours	LINEAR ALGEBRA	Credit Hours
Theory = 45 Practical = 0 Total = 45	**MAT-102 | 2nd Semester** **(B.Sc. Agricultural Engineering)**	**3(3-0)** Theory = 3.0 Practical = 0.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DEFINE and demonstrate properties of matrices used to solve systems of linear equation	Cognitive	C2	PLO1	PEO1
CLO2	DEMOSTRATE the solution of first and higher order ODEs using conventional methods	Cognitive	C3	PLO2	PEO1
CLO3	APPLY the techniques of Linear Algebra and optimization for solution of Agricultural Engineering problem	Cognitive	C3	PLO4	PEO1

Area Scope:

The knowledge units in this area collectively encompass the following:

- To comprehend basic concepts of Linear Algebra and optimization
- To apply techniques of Linear Algebra and optimization for solution of engineering problems

Course Outline:

1. **System of Linear Equations and Applications**
    - **a.** Overview of linear system of equations, Cases of unique solution, No solution and infinite solutions,
    - **b.** Echelon form, Gauss elimination method, Inversion of matrix in the context of solution of system of equations, LU factorization, Row space and column space
    - **c.** Relevant engineering case studies such as Network analysis, Traffic Flows, Balancing chemical reaction, Leontief Input-output model, Finding max stress in compound cylinder, Applications of linear systems in force balancing of structures, Markov process
2. **Vector Spaces and Transformations**
    - **a.** Vector Spaces: Real vector spaces, Subspaces, Basis and dimension, Rank, Nullity
    - **b.** Gram-Schmidt process for finding orthonormal basis
    - **c.** Linear Transformation, Kernel of Transformation, Range of Transformation, Matrix of Transformation,
    - **d.** Applications: Cryptography, Coding and decoding, Breaking of codes, Robotic Applications of linear transformations
3. **Eigenvalues and Eigen Vectors**
    - **a.** Eigenvalues, Eigenvectors, Similar matrices, Diagonalization,
    - **b.** Quadratic forms, Positive definite Matrices, Singular Value Decomposition, Inner product Spaces
    - **c.** Applications of linear Algebra: Constructing curves and surfaces, Computer graphics, Genetics
4. **Linear Programming**

a. Solution Introduction to linear programming, Optimization, Graphical method, Simplex method, Optimization problems in engineering and economics
b. Dual simplex methods, Duality theory, Primal and dual problems, transportation models, north-west corner, least-cost and Vogel's approximations methods,
c. Assignment model, the transshipment model and other relevant engineering case studies

5. **Application of Linear Algebra in Dynamical Systems**
   a. Numerical System of linear ODEs, Eigenvalue problems, Homogeneous and nonhomogeneous system of ODE.
   b. Dynamical systems, Population dynamics, Prey-Predator models, Stability analysis

Teaching Methodology (Proposed as applicable))
Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:
1. Introductory Linear Algebra: By Bernard Kolman and David R. Hill, Latest Edition.
2. Elementary Linear Algebra: By Howard Anton and Chris Rorrers, Latest Edition.

ENG-102 Technical Writing and Presentation Skills 3(3-0)

Contact Hours	**TECHNICAL WRITING AND PRESENTATION SKILLS**	**Credit Hours**
Theory = 45	**ENG-102 | 2nd Semester**	**3(3-0)**
Practical = 0	**(B.Sc. Agricultural Engineering)**	Theory = 3.0
Total = 45		Practical = 0.0
		Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN the foundations of human communication process	Cognitive	C2	PLO6	PEO2
CLO2	DESCRIBE the ability of effective written communication by writing effective reports	Affective	A2	PLO10	PEO2
CLO3	DEVELOP written and oral multimedia presentation skills by preparing presentation materials	Affective	A4	PLO10	PEO2

Area Scope:

The knowledge units in this area collectively encompass the following:

- Communicate effectively using intermediate- to-advanced level English while developing the understanding of essentials of communication skills.
- Participate in group discussions by attentive listening, questioning to clarify ideas, eliciting responses, or disagreeing in a constructive way.

Course Outlines:

By the end of the semester students will have skills including:

- **Writing Skills**
  a. Vocabulary Building
  b. Writing Skills: Essays and Letters
  c. Common Writing Errors
  d. Purposeful Writing
- **Reading Skills**
  a. Skimming and Scanning
  b. Critical Reading
  c. Reading for Understanding
  d. Techniques and strategies to develop sound vocabulary.
- **Listening Skills**
  a. Introduction to Communication Process
  b. Seven Cs of Communication
  c. Types of Listening
  d. Listening for Comprehension
- **Speaking Skills**
  a. Verbal and Non-Verbal Communication
  b. Basics of Presentation Skills
  c. Presentation Strategies and public speaking skills.
  d. Use of Audio-Visual Aids
  e. Basics of Group Communication
  f. Listening Skills
  g. Communicate effectively in job interviews.

Teaching Methodology (Proposed as applicable))

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Anchor in English-II (Lessons 1-5), A SPELT Publication
2. Christopher Fry, “Summary Writing (Book-I)”, Oxford University Press
3. College Essays by John Langlan

4. Barron's TOFFL iBT Edition
5. Communication Skills for Engineers by Sunita Marshal and C.Muralikrishna

ARAB-152 Translation of the Holy Quran I I (1-0)

Contact Hours Theory = 15 Practical = 0 Total = 15	**TRANSLATION OF THE HOLY QURAN II** **ARAB-152 | 2nd Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 1(1-0)** Theory = 1.0 Practical = 0.0 Total = 1.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the basic beliefs of Islam, through the translation of Arabic texts of QURAN.	Cognitive	C1	PLO8 & PLO12	PEO3
CLO2	DISCUSS the Islamic civilization and culture, human rights in Islam, the lawful in Islamic sharia through the translation of Arabic texts of QURAN	Cognitive	C2	PLO6 & PLO12	PEO3

تجوید اور قرآنی عربی

Year-2										
Third Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-201	Soil Mechanics	Engineering	Core Breadth of Engg discipline		WK4	3(2–1)	2	1	3
2	SEE-201	Engineering Mechanics	Engineering	Engineering Foundation		WK3	3(2-1)	2	1	3
3	FMP-201	Applied Thermodynamics	Engineering	Engineering Foundation		WK3	3(2-1)	2	1	3
4	FMP-203	Manufacturing Engineering	Engineering	Engineering Foundation		WK4	2(1-1)	1	1	2
5	CHM-102	Industrial Chemistry	Non-Engineering	Natural Sciences	Chemistry	WK1	3(2-1)	2	1	3
6	CSC-201	Computer Programming	Engineering	Computer and Information Science	ICT/AI/Data Sciences/ Cyber Security	WK2	3(3-0)	2	1	3
7	ARAB-251	Translation of the Holy Quran III	Non-Engineering	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**11**	**6**	**17**

* The syndicate in its 1/2021 meeting held on 23-01-2021 approved the recommendation 4/2020 meeting of Academic Council dated 10.08.2020 that the course Translation of Holy Quran will like “Qualify only. The decision of the syndicate was notified Vide letter No. Acad/BOS-Misc/2213 dated 24.02.2021.

I&D-201 **Soil Mechanics** **3(2-1)**

Contact Hours Theory = 30 Practical = 45 Total = 75	**Soil Mechanics** **I&D-201 | 3rd Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO 1	**DESCRIBE** soil formation processes, associated physical properties, classification of soil, soil stability and compaction, soil permeability, soil bearing capacity, vertical stresses, and soil exploration	Cognitive	C2	PLO1	PEO1
CLO2	**APPLYING** formulae, Laws and basic concepts to solve the engineering problems related to Soil Mechanics	Cognitive	C3	PLO2	PEO1
CLO3	**PERFORM** soil mechanics experiments and assigned activities	Psychomotor	P3	PLO4	PEO3

Course outlines:

1. Soil Formation:
   a. Soil and its Constituents,
   b. Weathering of Rocks and Types of Soils,
   c. Description and identification of soil (Visual-Manual Procedure),
   d. Mineralogy of Solids.
2. Physical Properties:
   a. Water Content, Void Ratio, Porosity, Degree of Saturation, Specific Gravity,
   b. Unit Weight and their determination,
   c. Atterburg's limits,
3. Classification of Soils:
   a. Sieve Analysis,
   b. Hydrometer and Pipette Analysis, Stoke's Law, Grain Size distribution.
   c. Grain Size Classification;
   d. Bureau of Soils, M.I.T. Unified, AASHTO and ASTM Classification systems.
   e. Textural Classification by Triangular Chart, Unified Soil Classification,
   f. AASHTO Soil Classifications.
4. Soil stability Analysis

a. Retaining Walls, Definition, purpose and classification,
b. forces acting on earth retaining structures.
c. Lateral earth pressure.

5. Compaction:
   a. Purpose and theory of Compaction,
   b. Moisture Content and Dry Density relationship,
   c. Standard Proctor Compaction Test, Modified Proctor Compaction Test,
   d. Degree of Compaction and its determination in the
   e. Field Methods of compaction in the field;
   f. Factors affecting compaction of soils.
6. Soil Permeability and Seepage
   a. Darcy's law, Hydraulic conductivity
   b. Laboratory determination of Hydraulic Conductivity,
   c. Directional variation of permeability
   d. Equivalence hydraulic conductivity
   e. Continuity equation for solution of simple flow problems
   f. Flow nets and seepage calculation from flownet
   g. Seepage through and earthen dam on an impervious base
7. Vertical Stresses in Soils:
   a. Definition, Stresses caused by self-weight of soil,
   b. Geostatic stresses, stresses caused by Point Loads and Uniformly Distributed Loads:
   c. Boussinesq and Westergarrd theories,
   d. Pressure bulb, Stress distribution diagram on horizontal and vertical,
   e. Stress at a point outside loaded area, Newmark's charts and 2:1Method.
8. Bearing Capacity of Soil:
   a. Definition of bearing capacity.
   b. Factors affecting bearing capacity,
   c. Classification of foundations.
   d. Stability requirements of a foundation.
9. Soil Exploration:
   a. Importance of Soil Exploration,
   b. Soil Exploration methods,
   c. Probing, Test Trenches and Pits,
   d. Auger boring, wash boring, rotary boring,
   e. dewatering
   f. Percussion drilling and Geophysical methods, Sol Samples, Disturbed and Un-disturbed samples, In-situ Tests (SPT, CPT and PLT).

Practical:

- Identification of Soil (Visual and Manual)
- Determination of Moisture Content of Soil
- Determination of Specific Gravity of Soil
- Determination of Liquid Limit of Soil
- Grain Analysis of Soil (including both Mechanical and Hydrometer Analysis)
- Determination of Plastic Limit and Plasticity Index of Soil

- Determination of Shrinkage Limit of Soil
- Modified/Proctor Compaction Test
- Determination of consolidation under given load.
- Determination of shear strength of soil.

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Budhu, M. 2015. Soil Mechanics Fundamentals. John Wiley and Sons Ltd. United Kingdom.
2. Das, B.M, and K. Sobhan, 2017, Principles of Geotechnical Engineering. Eighth Edition, SI, Cengage Learning, 200 First Stamford Place, Suite 400, Stamford, CT06902, USA
3. Duncan, J.M. 2014. Soil Strength and Slope Stability. 2ndEdition, John Wiley and Sons, Hoboken, New Jersey.
4. Jumikis, A.R. 1994. Soil Mechanics, D. Van Nostrand Company Inc., Princeton, New Jersey.
5. Terzaghi, K. 1997. Soil Mechanics in Engineering Practice. John Wiley and Sons, New York.

SEE-201 Engineering Mechanics 3(2-1)

Contact Hours	**ENGINEERING MECHANICS**	**Credit Hours**
Theory = 30 Practical = 45 Total = 75	**SEE-201 | 3rd Semester** **(B.Sc. Agricultural Engineering)**	**3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DEFINE and EXPLAIN principles of engineering mechanics (i.e. statics and dynamics)	Cognitive	C2	PLO1	PEO1
CLO2	SOLVE problems of engineering statics and dynamics using principles of engineering mechanics.	Cognitive	C3	PLO3	PEO1
CLO3	PERFORM the experiments related to engineering mechanics	Psychomotor	P2	PLO2	PEO3
CLO4	DEMONSTRATE the assigned task reliably independent of help.	Psychomotor	P3	PLO9	PEO2

Course Outline:

1. Introduction:
    a. Concept of measurement of mass, force, time and space,
    b. Systems of units, Fundamentals and Derived units, Conversion of units, required
    c. Accuracy of results, General Principles of Statics
2. Force Systems – FBD
    a. Vector addition, Subtraction and Products,
    b. Resultant of Distributed (Linear and Non-linear) force Systems
    c. Equilibrium: General conditions of equilibrium of Co-planer forces, Laws of Triangle, Parallelogram and Polygon of forces
3. Distributed Forces:
    a. Types of beams, Supports and Loads,
    b. Simple cases of Axial forces, Shear forces and Bending Moment diagrams
4. Friction:
    a. Problem involving friction on Flat surfaces,
    b. Geometrical Properties of Plane Areas
5. Work and Energy: Work, Energy, Power
    a. Impulse and Momentum: Impulse,
    b. Momentum, Conservation of Momentum and Energy
6. Kinematics of Particles:
    a. Rectilinear and Curvilinear motions,
    b. Tangential and Normal Components of Acceleration, Simple Harmonic motion
7. Dynamics Analysis of components/System

Practical:

Verification of the law of polygon of forces, the law of parallelogram of forces, the principles of moments, the co-efficient of friction between surfaces. Special numerical problems and assignments, Moment of inertia of fly wheel mounted on wall and a wooden block by suspension. Modulus of rigidity of metal bar by static and dynamic methods. Special numerical problems and assignments.

Teaching Methodology (Proposed as applicable))

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Singer, F.L. 2000. Engineering Mechanics. Harper and Row Publishers, New York.
2. Meriam, J.L. and L.G. Kraige. 1993. Engineering Mechanics. Vol.I Statics. John Willy and Sons, New York.
3. Higdon, A. and W.B. Stile. 1986. Statics and Dynamics. Prentice-Hall, Inc. Englewood Cliffs, N. J., USA.
4. Riley, W. and Struges, C.d. 1996. Engineering Mechanics, Statics and Dynamites, John Wiley and Sons Inc., New York.

5. Bedford, A. and Fowler, W., 1994 Engineering Mechanics: Statics and Dynamics, Addison-Wesley Publishing Company. New York.
6. McGill. D.J. and King, W.W., 1994 Engineering Mechanics: Statics and Dynamics, PWS publishing Co., New York.

FMP-201 Applied Thermodynamics 3(2-1)

Contact Hours Theory = 30 Practical = 45 Total = 75	**APPLIED THERMODYNAMICS** **FMP-201 | 3rd Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the thermodynamics laws and explain their importance in the field of thermodynamics.	Cognitive	C2	PLO1	PEO1
CLO2	ANALYZE the principle of thermodynamics air cycles for producing mechanical power and characterize different types of fuels and explain the combustion of fuels.	Cognitive	C4	PLO2	PEO1
CLO3	DEMONSTRATE the properties and thermodynamic processes of perfect gasses by applying fundamental knowledge of thermodynamics and environmental aspects.	Cognitive	C3	PLO1	PEO1
CLO4	OPERATE various thermodynamics systems under different conditions and analyze their performance.	Psychomotor	P3	PLO2	PEO3

Course Outlines:

1. **Heating and expansion of gases:**
    a. Units of heat, gases and vapors, constant volume and constant pressure,
    b. P-V diagram, specific heat of gases, internal energy of gas,
2. **Laws of perfect gases:**
    a. Law of conservation of energy, methods of heating and expanding gases and vapors,
    b. Heating of gases work done by gas in expanding

c. Equations for different types of heating methods

3. **Laws of thermodynamics**,
    a. Derivation of laws
    b. Practical applications of thermodynamics laws
4. **Air cycles:**
    a. Cycles of operation, air standard efficiency of a cycle,
    b. reversible process, reversible cycles, reversibility and efficiency,
    c. Carnot cycle, Otto cycle, diesel cycle,
5. **Entropy of gases**:
    a. Entropy and heat, T-S diagrams,
    b. Carnot, Otto, diesel and dual combustion cycles on T-S diagrams
6. **Air compressors:**
    a. Compressor functions and types,
    b. Reciprocating and rotary compressors,
    c. Single and multistage compressors,
    d. Cylinder clearance, work done, compressor efficiency
7. **Compound expansion**
    a. Advantages of compound expansion, tandem type of two-cylinder compound engine
    b. Receiver type compound engine; combined indicator diagram for compound engine
    c. Calculations for cylinder uniflow engine.
8. **Refrigeration:**
    a. Definition and principle
    b. Coefficient of performance, units of refrigeration, air compression refrigeration
    c. vapor compression refrigeration, refrigeration cycles
    d. quality of refrigerant and general considerations
    e. heat pumps and components

Practical:

1. Study of working principles of two stroke and four stroke engines using models.
2. Demonstration of Joule's law.
3. Measurement of rotary and reciprocating air compressors efficiency and their characteristic curves.
4. Determination of PV diagram of diesel/gasoline engines.
5. Analysis of engine flue gases for CO, CO2, NO2, etc.
6. Determination of fuel energy content (heating value), viscosity, pour point, flash point and gravity.
7. Thermodynamic analysis of refrigeration and air conditioning cycles.
8. Visits to industries
9. Lecture by invited guest speaker

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Recommended Books:

1. Li, K., 2018. Applied thermodynamics: availability method and energy conversion. Routledge.
2. Rajpot, R.K. 2015. Applied Thermodynamics. 2 edition, Jain Book Agency, New Delhi, India
3. Nag. 2013. Engineering Thermodynamics. 5 Edition, Jain Book Agency, New Delhi, India.
4. Khurmi, R.S. and J.K. Gupta. 2000. Thermal Engineering. S. Chand and Co. Ltd., New Delhi, India.
5. Sontagg,R.E.and G.J.Van Wylen. 2003.Fundamentals of thermodynamics. 6 Ed, John Willey and Sons, Inc. New York, USA.
6. Jones, J.B. and Hawkais, G.A. 2002. Engineering Thermodynamics. John Willey and Sons, Inc. N.Y., USA.
7. Lewitt E. H. 2002. Thermodynamics applied to heat engines, Issac Pitman and Sons, London
8. Eastop,T.D. 2004. Applied thermodynamics for engineering and technologists. 5 Ed.Pearson Education Singapore.

FMP-203 Manufacturing Engineering 2(1-1)

Contact Hours Theory = 15 Practical = 45 Total = 60	**MANUFACTURING ENGINEERING** **FMP-203 | 3rd Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours** **2 (1-1)** Theory = 1.0 Practical = 1.0 Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DEFINE manufacturing engineering and identification manufacturing machine	Cognitive	C1	PLO1	PEO1
CLO2	DESCRIBE lathe, drilling, milling, shaping and planning machines operation., CAM/CIM, 3D printing and TQM	Cognitive	C2	PLO1	PEO1
CLO3	PERFORM the lathe and drilling milling and other manufacturing processes	Psychomotor	P2	PLO9	PEO3

Course Outlines

1. Introduction

a. Define manufacturing engineering

b. Identify the common tools, processes and machines used in manufacturing engineering

2. Lathe Machines

a. Describe turning and related operations commonly performed on lathe machines

b. Demonstrate the different types and construction of lathe and its accessories
c. Carry out different lathe operations
d. Illustrate turret lathe and turret lathe tooling
e. Demonstrate the mechanism of chip formation
f. Describe different types of cutting tools and their materials
g. Discuss the tool failure, tool life and the use of coolants

3. Drilling, Reaming and Grinding

a. Explain and illustrate different types of drilling machines, drill bits and drill chucks
b. Carry out counter boring and sinking
c. Discuss and illustrate boring and reaming practices and tools
d. Carry out the estimation of drilling time

4. Milling

a. Describe the different types and working principle of milling machines
b. Demonstrate and discuss milling operations and mill cutters
c. Carry out the estimation of milling time

5. Shaping and Planning

a. Discuss types and applications of shapers and planers
b. Explain the shaper drive mechanism
c. Demonstrate and describe shaper speeds and machining times
d. Discuss the construction and types of planning machines
e. Illustrate planer tools and work set up methods
f. Demonstrate and discuss metal bending and sheet rolling processes

6. CAM and CIM Systems

a. Describe CAM and CIM systems
b. o Discuss different types of CNC machines and their working principles
c. o Demonstrate programming for numerical control
d. o Illustrate the machine tool control

7. Additive Manufacturing

a. Discuss 3D printing and its prospects
b. Describe total quality management (TQM) in manufacturing

Practical:

- Fabrication of various machine elements using lathe.
- Making a slot on a shaft for a cotter pin using shaper and milling machines
- Cutting threads using milling and lathe machines
- Making holes in machine parts using drilling machines.
- Making bends of metal sheet using sheet rolling machines
- Fabrication of a given agricultural machinery part.
- Local visits to agricultural Machinery Manufacturing Industries.
- Study and use of CAD/CAM lab tools.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Ram, M., J. P. Davim. 2018. Advanced Applications in Manufacturing Engineering. 1st Ed. Published by Woodhead Publishing, UK.
2. Kalpakjin, S. and S. R. Schmid. 2016. Manufacturing engineering and technology. 6th Ed., Published by Pearson Publishing Co., London, UK.
3. Nee, A.Y.C. 2015. Handbook of Manufacturing Engineering and Technology. Published by Springer-Verlag London, UK.
4. Alavala, C. R. 2013. CAD/CAM: Concepts and Applications. Published by PHI Learning Pvt. Ltd., New Delhi, India.

CHM-102 **Industrial Chemistry** **3(2-1)**

Contact Hours	**INDUSTRIAL CHEMISTRY**	**Credit Hours 2(1-1)**
Theory = 30 Practical = 45 Total = 75	**CHM-102 | 2nd Semester** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	UNDERSTAND the basic terminologies of industrial chemistry and water technology	Cognitive	C2	PLO1	PEO1
CLO2	EVALUATE industrial/chemical processes to manipulate for large scale production of sugar, oil/ghee	Cognitive	C3	PLO4	PEO1
CLO3	PERFORM the practical work in laboratory to take qualitative/quantitative results	Psychomotor	P3	PLO9	PEO3

Course Outlines
Introduction of unit operation and processes, industrial, irrigation and municipal water, metallic corrosion and its inhibition, paints and varnishes, fats and oils, extraction, refining and hydrogenation of oils, sugar industry and its by-products, nitrogenous, phosphatic and potassic fertilizers.

Practical

Sampling of water, water analysis for carbonates, bicarbonates, chlorides and sulphates, determination of pH and TDS, analysis of molasses, estimation of nitrogen, potassium and phosphorous in fertilizers, analysis of an oil for acid value, Sponification value and iodine value.

Books Recommended

1. Agarwal, O.P., A. Agarwal, 2001. Engineering Chemistry. Khana Publishers, India.
2. Kent, A.J. 1997. Riegel's Hand Book of Industrial Chemistry. CBS Publisher New Delhi, India.
3. Shreve, R.H. 1987. The Chemical Process Industries. McGraw Hill Book Co., New York.

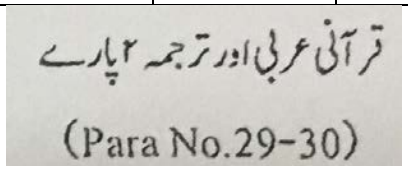
ARAB-251 Translation of the Holy Quran III (1-0)

Contact Hours Theory = 15 Practical = 0 Total = 15	**TRANSLATION OF THE HOLY QURAN III** **ARAB-251 | 3rd Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 1(1-0)** Theory = 1.0 Practical = 0.0 Total = 1.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the basic beliefs of Islam, through the translation of Arabic texts of QURAN.	Cognitive	C1	PLO8 & PLO12	PEO3
CLO2	DISCUSS the Islamic civilization and culture, human rights in Islam, the lawful in Islamic sharia through the translation of Arabic texts of QURAN	Cognitive	C2	PLO6 & PLO12	PEO3



Year-2										
Fourth Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-202	Open Channel Hydraulics	Engineering	Core Depth of Engg discipline		WK5	3(2-1)	2	1	3
2	SEE-202	Strength of Materials	Engineering	Core Breadth of Engg discipline		WK4	3(2-1)	2	1	3
3	SEE-204	Environmental Engineering	Engineering	Core Breadth of Engg discipline		WK4	3(2-1)	2	1	3
4	FMP-202	Instrumentation and Control	Engineering	Engineering Foundation		WK3	3(2-1)	2	1	3
5	AEM-202	Occupational Health and Safety	Engineering	MDE		WK2	2(1–1)	1	0	1
6	SES-202	Soil Science	Non-Engineering	Natural Sciences	Agri Sciences	WK1	2(1-1)	1	1	2
	SSH-202	Ideology and Constitution of Pakistan	Non-Engineering	Humanities	Culture	WK7	2(2- 0)	2	0	2
7	ARAB-252	Translation of the Holy Quran IV	Non-Engineering	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**12**	**5**	**17**

I&D-202 **Open Channel Hydraulics** **3(2-1)**

Contact Hours Theory = 30 Practical = 45 Total = 75	**Open Channel Hydraulics** **I&D-202| 4th Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours** **3 (2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN fundamental concepts of open channel flow	Cognitive	C2	PLO1	PEO1
CLO2	APPLY principles of hydraulic engineering to open channel flow	Cognitive	C3	PLO2	PEO1
CLO3	PERFORM experiments related to flow through open channel and ESTIMATE the hydraulic parameters using experimental data	Psychomotor	P3	PLO3	PEO3

Course outline:

1. Basic Concepts of Free Flow:

a. Types, state and regimes of flow,
b. channel flow types, (steady, unsteady, uniform and non-uniform, mixed flow)
c. channel geometry,

2. Energy and Momentum Principle:

a. Basic equations,
b. specific energy and alternate depths,
c. E-Y relationship,
d. criteria for a critical state of flow,
e. Computation of critical flow,
f. control of flow,
g. Application of flow control in rectangular channel,
h. momentum in open channel flow, specific momentum,
i. hydraulic jump,
j. M-Y relationship.

3. Velocity Measurement in Channel

a. velocity distribution in channel and its coefficients,
b. pressure distribution in channel,
c. effect of slope on pressure distribution.

4. Uniform Flow:

a. Establishment of uniform flow.
b. The Chezy's and Manning's equations,

c. resistance coefficient estimation,
d. normal depth and velocity,
e. normal and critical slopes,
f. free board,
g. Determination of section dimensions.
h. best hydraulic section,

5. Rapidly Varied/ Turbulent Flow:

a. Characteristics of varied flow,
b. Types of weirs, sharp crested weir and board crested weir,
c. Aeration of the nappe crest shape
d. discharge over spillway,
e. type of the hydraulic jump,
f. characteristics of the hydraulic jump,
g. jump as energy dissipater,
h. flow through sudden transitions.

Practical:

- Determination of discharge in open channel through different methods.
- Development of stage-discharge curve (Y-Q Relationship)
- Measurement and development of hydraulic jump
- Flow measurement through/over different hydraulic structures
- Determination of critical flow, critical depth and alternative depth
- Determination of Chezy's and Manning's 'n' for a rectangular prismatic channel
- Plotting flow profile (HGL and EL) of an open channel

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Chow, V.T. (1990). Open Channel Hydraulics. McGraw Hill International Book Company.
2. French, R. H. (1996). Open Channel Hydraulics, McGraw Hill International Book Company.
3. Henderson, F.M. (1990). Open Channel Flow. McMillan Publishing Co.

SEE-202 **Strength of Materials** **3(2-1)**

Contact Hours	**STRENGTH OF MATERIALS**	**Credit Hours**
Theory = 30	**SEE-202 | 4th Semester**	**3(2-1)**
Practical = 45	**(B.Sc. Agricultural Engineering)**	Theory = 2.0
Total = 75		Practical = 1.0
		Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN different types of stresses and related laws	Cognitive	C2	PLO1	PEO1
CLO2	ANALYZE stress and strain transformations in structural members	Cognitive	C4	PLO2	PEO1
CLO3	PERFORM experiments related to advanced mechanics of materials	Psychomotor	P3	PLO5	PEO3

Course Outline:

1.Stress and strains:
   a. Stress at a point, components of stress,
   b. analysis of plane stress, principle stresses,
   c. maximum shear stress, Mohr's circle.

2.Axial loading:
   a. Stress due to axial forces, strain,
   b. properties of material under axial loading.

3.Bending and Torsion: Bending stresses in beams, shear and bending moment diagrams.
   a. Combined loading: Stresses due to axial, bending and torsional loading.
   b. Deflection: Moment-curvature relationship, deflection of beams by the method of double integration.
   c. Deflection of beams: Double integration method with singularity function, area moment method, Torsion: Shearing stress and angle of twist, hollow and circular shafts.

4.Buckling: Pin ended column, eccentrically loaded column, initially curved column, critical loads and critical stresses.

5.Curved beams: Stresses in curved bars. Cylinders and spheres: Stresses in thin and thick walled cylinders.

6.Fatigue loading: analysis and design.

7. Software applications

8. SAP 2000

Practical:

- Verification of Hook's law
- Determination of torsion and deflection
- Measurement of forces on supports statically determinant beams
- Determination of shear forces in beams
- Determination of bending moments in beams
- Measurement of deflection in statically determinant beams
- Measurement of strains in a bar
- Bend test in steel bar

- Yield/Tensile strength of steel bar

Teaching Methodology (Proposed as applicable))
Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Andrew Pytel, Ferdinand L. Singer. Strength of Materials
2. Sarkar B.K. 2006. Strength of Materials, Tata McGraw-Hill Publishing Pvt. Ltd. New Delhi
3. Muvdi, B.B. and J.W. Mcnabb. 2001. Engineering Mechanics of Materials. MacMillan Publishing Co. New York.

****The course contents, CLOs and associated mapping is updated by the Board of Studies of Agricultural Engineering in its meeting held on 26th May 2022**

SEE-204 Environmental Engineering 3(2-1)**

Contact Hours Theory = 30 Practical = 45 Total = 75	**ENVIRONMENTAL ENGINEERING** **SEE-204 | 4th Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

Course Learning Outcomes (CLOs) and CLO Mapping
Upon successful completion of the course, the student will be able to:

CLO	Statement	Learning Domain	PLO	PEO
CLO1	**Understand and Describe Environment**, Contamination and Pollution issues **in** major Subsystems of Liquid, Solid and Gas Environment. **Explain the role of E**nvironmental Engineer.	**C2** Understanding	**PLO1** Engg Knowledge	1
CLO2	Quantitatively **Analyze** Environmental Systems and the Liquid, Solid and Air Pollution Control Systems	**C4** Analyzing	**PLO7** Environment and sustainability	3
CLO3	**Assess** physical, chemical, and biological Water and Wastewater Characteristics and **Evaluate** the respective Treatment Systems	**C5** Evaluating	**PLO4** Investigation	2
CLO4	**Perform** the assigned environmental lab tasks as instructed reliably and effectively	**P3** Guided Response	**PLO9** Individual & teamwork	2

Course Outline

Introduction to Environmental System

a) Environmental Engineering Concepts, Definitions and Principles
b) Professional and Environmental Engineers' Roles and Challenges
c) Env. Subsystems: Water-Wastewater, Solid-Soil and Air-Atmosphere + Noise
d) Environmental Sustainability, Legislation and Regulations

Environmental Chemistry and Biology

a) Basic Chemical Concepts and Functional groups
b) Water Chemistry, Soil and Atmosphere
c) Organics, The Cell, Energy and Metabolism
d) Bacteria, Archaea, Protozoa, Algae, Fungi and Viruses

Env. Systems Analyses: Materials& Energy Balance

a) Unifying Theories and Key Tools for Quantitative Analyses of Env Systems
b) State of Mixing, Chemical Reactors Conservative/Non-Conservative Situations
c) Reactor Types and Reactor Analyses

Ecosystems and Sustainability

a) Human and Natural Systems
b) Nutrient Cycles and Energy Cycling
c) Sustainable Development and Resource Conservation

Water Quality Management

a) Water Contaminants: Point/Non-point Sources, Oxygen Demanding (OD) Materials, Solids, Nutrients, Organics and Pathogens
b) BOD and COD (Biochemical and Chemical OD), BOD rate constant, BOD5, uBOD, BOD Exertion Curves, Carbonaceous and Nitrogenous BOD
c) Water Quality Management in Rivers, Lakes etc. DO Sag Curve and Reaeration
d) Contaminant Migration in Groundwaters and Source Water Protection

Water Treatment

a) Water Quality (WQ) Characteristics and Standards for Drinking and Irrigation
b) Water Treatment Plant and Major Components of Treatment Works
c) Unit Treatment Operations/Processes: Rapid Mixing, Flocculation, Coagulation, Sedimentation, Softening, Filtration, Disinfection with Chlorine Ozon and UV, Other Processes and Water Plant Residuals

Wastewater Treatment (WWT)

a) WW Characteristics, WWT Standards, WWT levels and Unit Ops/Processes
b) Pre-Treatment and Primary Treatment (Conventional, Hi Rate)
c) Secondary (Conventional, BNR), Tertiary and Advanced WWT
d) WW Sludge Processing and WWT Plant Residuals Management

Solid Waste Management (SWM), Air Pollution and Noise Control

a) Solid Waste (SW) Generation, Characteristics and Composition
b) SWM Strategies: (3/4Rs) Reduce, Recover, Reuse and Recycle.
c) SW Collection, Segregation, Recovery, Processing, Recycling and Disposal
d) Air Pollution Considerations, Standards and Effects
e) Dispersion and General Air Pollution Control
f) Noise Considerations, Exposure Impacts, Standards and Protection

Practical Work

1. **Environmental Lab Safety Precautions** and **Identification** and Demonstration of **Equipment** in Environment and Water Quality Lab
2. Identification of **Laboratory Glassware**
3. Determination of **pH and EC** of water and wastewater (W/WW) samples
4. Determination of **DO, Turbidity and Color** of W/WW samples

5. Determination of **Solids TS, TSS and TDS** of WW
6. Determination of **VS, VSS and FS, FSS** of WW
7. Measurement of **Chemical Oxygen Demand (COD)** of WW samples
8. Measurement of **Biological Oxygen Demand (BOD)** of WW samples
9. Determination of **Alkalinity** and **Hardness** of W/WW
10. Jar Test for Optimum **Coagulant Dose**

Teaching Methodology

Lecturing, Written Assignments/Quizzes, Report Writing, Case studies

Assessment

Mid Term, Report writing/Presentation, Assignments, Quizzes, Final Term

Suggested Books

1. Mihelcic, James R., Zimmerman, Julie B. "Environmental engineering: Fundamentals, Sustainability, Design". John Wiley & Sons, 2021.
2. Liu, D. H., & Lipták, B. G. (Eds.). "Wastewater treatment". CRC Press, 2020.
3. Kutz, M., ed. "Handbook of Environmental Engineering". John Wiley & Sons, 2018.
4. Mackenzie L., Davis, Susan J., Masten. "Principles of Environmental Engineering and Science". McGraw Hill, 2014.
5. Metcalf and Eddy. "Wastewater Engineering: Treatment and Reuse", 4th ed. McGraw Hill, ISBN: McGraw-Hill, 2013.

FMP-202 Instrumentation and Control 3 (2-1)

Contact Hours	**INSTRUMENTATION AND CONTROL**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**FMP-202| 4th Semester** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN the fundamentals of instrumentation and measurement systems.	Cognitive	C2	PLO1	PEO1
CLO2	ANALYZE the working principles of sensors and transducers and effectively choose a particular sensor/transducer for a particular application.	Cognitive	C3	PLO2	PEO1
CLO3	PERFORM the experiments related to engineering mechanics	Psychomotor	P2	PLO9	PEO2

CLO4	DEMONSTRATE the instrumentation and measurement system	Psychomotor	P3	PLO9	PEO2

Course Outline:

1. Introduction

a. Basic terminologies, concepts related to instruments
b. Instrument behavior application of instrumentation,

2. Functional elements of instruments

a. Error of instrument, uncertainty analysis,
b. Least square techniques, static and dynamic characteristics of instrumentation
c. Signal conditioning and recording devices

3. Principles and Theory of Electrical Instruments

a. Potentiometer, wheat stone bridge
b. Strain analysis; strain measurement; strain gauges, types and their applications

4. Displacement, Velocity and Acceleration Measurement

a. Sensors and transducers, displacement measurement sensors; potentiometer,
b. LVDT, capacitance sensors, piezoelectric sensors.
c. Velocity and acceleration sensors Force and Torque

5. Force Measurements

a. Load cells, Torque measurements
b. Torque cells.

6. Pressure Measurement

a. Gauge, vacuum and absolute pressure
b. Pressure measuring devices

7. Measurement of Temperature

a. Resistance thermometer
b. Thermocouples and radiation methods

8. Fundamentals of Mechatronics

a. Introduction to electronics and sensors used in agricultural machinery
b. Interfacing the machine and computers for response
c. Controls and data logging
d. Computer simulation of mechanical system

Practical:

- Measurement of Displacement by LVDT and Potentiometer.
- Measurement of wind velocity.
- Measurement of Force by Strain Gauges.
- Calibration of pressure gauges with dead weight tester
- Measurement of Temperature by thermocouples.
- Computer inter-facing for the depth and draft controls of tractors.
- Visit to Mechatronics labs of different institutions.
- Study of depth sensors in Agricultural Machinery

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Mahalik, N. P. 2003. Mechatronics, principles, concepts and applications. Tata McGraw-Hill, New Delhi, India
2. Necsulescu, D. S. 2002. Mechatronics, Prentice Hall Inc., N.J., USA.
3. Figliola, R. S. and D. E. Beasley. 3 Ed. 2004. Theory and design for Mechanical measurements. John Willey and Sons (Asia) Pte, Inc. Singapore
4. ally, J. W. W. F. Riley and K. G. McConnel. 2003. Instrumentation for engineering measurements, 2 ed. John Willey and Sons, Inc. Singapore
5. Shetty, D. and R. A. Kolk. 2001. Mechatronics system design. Vikas Publishing House, Pvt, Ltd. New Delhi, India.

SES-202 Occupational Health and Safety **1(1-0)**

Contact Hours Theory = 15 Total = 15	**OCCUPATIONAL HEALTH AND SAFETY** **AEM-202 | 4th Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours** **1(1-0)** Theory = 1.0 Practical = 0 Total = 1.0

COURSE LEARNING OUTCOMES (CLOs)
Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE importance of Occupational Health and Safety as a nontariff barrier in international trade	Cognitive	C1	PLO8 & PLO12	PEO3
CLO2	Discuss ethical behavior principles in all areas of international trade and act accordingly	Cognitive	C2	PLO6 & PLO12	PEO3

Course Outline
Occupational Health and Safety Approach
Historical Development of Occupational Health and Safety
Historical Development of Occupational Health and Safety in Pakistan
Basic Concepts of Labor Law
Types of Employment Contract
Terms of Employment Contract

Termination of Employment Contract
Working Times Right to Rest and Vacation
The Effects of Physical Risk Factors on People Ways to
Avoid Physical Risk Factors
Employer's Liability Properties of Chemicals (Chemical Hazards)
Material Safety Data Sheet Storage and Labeling of Chemical Wastes
To Biological Risks Identification and Evaluation of Risks Measures to be Taken Against Risks
Aims of Ergonomics Scope and Goals of Ergonomics
Environmental Factors Noise Vision and Lighting Vibration Climate Ventilation
Emergency Legislation Emergency
Planning Preparation of Emergency
Plan Writing Phase of the Emergency
Plan Implementation of Emergency Plan
Classification of Accidents at Work Causes of Accidents at Work Employee's
Right to Avoid Work Registration and Notification of Occupational Accidents and Diseases
Definition of Occupational Diseases Historical Development of Occupational Diseases Characteristics of Occupational Diseases, Diagnostic Criteria and Prevention Methods Classification of Occupational Diseases
Working Environment Surveillance and Scope Duties of Occupational Health and Safety Institutions Ambient
Measurements Records and Statistics of Working Environment Surveillance
Basic Health and Safety Requirements Personal Protective Equipment List
Personal Protective Equipment Selection Criteria PPE Six Selection Method Personal Protective Equipment Usage Criteria
Basic concepts Risk Assessment Process Risk Assessment Team and Documentation
Electrical works Construction works Mining ect.

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:
Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:
Risk Med Akademi, (2012), Yeni Mevzuat Işığında İş Sağlığı ve Güvenliği Temel Bilgileri, Risk Med Akademi Yayınları. ♠ Koradecka, D., (2010), Handbook of Occupational Safety and Health, CRC Press: Taylor&Francis Group. ♠ Atatürk Üniversitesi (2019), İş Sağlığı ve Güvenliği, Atatürk Üniversitesi Açık Öğretim Fakültesi Yayını

SES-202 **Soil Science** **2(1-1)**

Contact Hours	SOIL SCIENCE	Credit Hours
Theory = 15 Practical = 45 Total = 60	**SES-202 | 4th Semester** **(B.Sc. Agricultural Engineering)**	**3(2-1)** Theory = 1.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	RECOGNIZE the basic knowledge and background about Soil science and soil fertility applied in Agri. Engineering	Cognitive	C2	PLO1	PEO1
CLO2	SOLVE the problems related to soil science	Cognitive	C3	PLO2	PEO1
CLO3	PERFORM the practical related to soil	Psychomotor	P3	PLO7	PEO3

Outline:

1. **Soil Perspective**
   What is soil? Edaphology and Pedology, A field view of soil, Soil profile, Subsoil and Surface soil, Mineral vs. Organic soils. Four major Components of Soils, Mineral constituents in soils, Soil organic matter, Soil water, Soil air, clay and humus.
2. **Important Physical Properties of Mineral Soils**
   Soil texture and Soil Structure, Classification of soil particles, Physical nature of soil separates, Soil texture classes. Mechanical analysis, Preparation of the Sample, Factors affecting dispersion, Methods for obtaining dispersion, Fractionation of the sample, Sieve method. Stokes' Law. Sedimentation methods, Determination of soil class, Particle and Bulk Density, Pore Space, Structure of mineral soils, Aggregation and its promotion, Structural management of soil, Soil Consistence.
3. **Soil Colloids**
   General constitution of Silicate clays, Adsorbed cations, Silicate clay structure, Classification of Silicate clays, Chemical Composition of silicate clays, Cation exchange capacity of soils, Plasticity, Cohesion, Swelling, Shrinkage, Dispersion and Flocculation.
4. **Soil Water**
   Structure and related properties of water, Soil water energy concept, Soil Moisture content versus Suction, Measuring Soil moisture, Capillary Fundamentals, Types of soil water movement, Saturated flow through soils, unsaturated flow in soils, Retention of soil moisture in the field, Conventional soil moisture classification, Factors affecting amount and use of available soil moisture, Capillarity and root extension.
5. **Soil Air and Soil Temperature**
   Soil aeration definition, soil aeration problems in the field, Composition of soil air., Factors affecting the composition of soil air, Fick's Law, Aeration in relation to soil and crop management. Soil temperature, Specific Heat of soils, Volumetric Heat Capacity,

Thermal diffusivity, and Conductivity, Fourier's Law, Movement of Heat in soil, Soil temperature control.

6. **Plant Nutrients and Fertilizers**
   Factors controlling the growth of higher plants, The essential elements from air, water and soil, Soil solution, Soil and plant interrelations, fertilizer elements, Nitrogen Fertilizers, Phosphates Fertilizers, Potassium Fertilizers, Mixed Fertilizers, Methods of applying solid fertilizers, Application of liquid Fertilizers.
7. **Saline and Sodic Soils**
   Climate and salinity, Some basic terms, Saline, Saline alkali and Sodic Soils, Diagnosis of Saline and Sodic Soils, Reclamation Steps of Salt-affected soils, Leaching Requirements, Crop tolerance to Salinity.

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Brady, N.C. (2008). The Nature and Properties of Soils (14th Edition). Macmillan Co. Ltd. USA.
2. Rashid, A. and K. S. Memon. (1996). Soil Science. National Book Foundation, Islamabad.
3. Tanji, K.K. 1990. Agricultural salinity assessment and management. ASCE No.71, New York, USA.
4. Gupta, I.C. 1990. Use of saline water in Agriculture. Oxford and IBH Pub. Co., New Delhi, India.

SSH-202 Ideology and Constitution of Pakistan 2(2-0)

Contact Hours	**IDEOLOGY AND CONSTITUTION OF PAKISTAN**	**Credit Hours**
Theory = 30	**SSH-202 | 4th Semester**	**2(2-0)**
Practical = 0	**(B.Sc. Agricultural Engineering)**	Theory = 2.0
Total = 30		Practical = 0.0
		Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE purpose and driving force behind the creation of Pakistan	Cognitive	C2	PLO6	PEO2

CLO2	EXPLAIN the foreign policy and futuristic vision of Pakistan and the economic issues and institutions in Pakistan.	Affective	A2	PLO12	PEO3
CLO3	ANALYZE cultural heritage of Pakistan and to study the impact of Islam in subcontinent	Affective	A5	PLO10	PEO2

Area Scope:

The knowledge units in this area collectively encompass the following:

- Have a better understanding of the rationale for the creation of Pakistan.
- Enable students to contribute in social, political and economic growth of Pakistan.
- Become a part of strong nation with a sense of ownership and responsibility towards Pakistan
- Play an active role toward sustainable development of Pakistan.

Course outline **Time Duration (Contact Hrs)**

1. Historical and Ideological Perspective **5 hrs**

a. Pakistan Movement
- Aligarh Movement
- Two Nations Theory

c. Founders of Pakistan
- Allama Muhammad Iqbal
- Quaid-e-Azam Muhammad Ali Jinnah
- Other Leaders (Women and other Pakistan Movement Leaders)

c. Quaid's Vision for Pakistan

d. Kashmir – An unfinished Agenda of Partition

2. Constitution of Pakistan **4 hrs**

a. An overview of constitutional development in Pakistan

b. Salient features of the Constitution of 1973

c. Constitutional Amendments

d. Fundamental Rights and Responsibilities of Citizens

3. Contemporary Pakistan **4 hrs**

a. Pakistan's society, culture and demography – celebrating diversity

b. Current Challenges: social, economic, environmental, political and external

c. Nation's resilience in War on Terror

4. Economy of Pakistan **4 hrs**

a. An overview of Economy

b. Services, Manufacturing and Agricultural Profile of Pakistan

c. Regional Economic Cooperation

d. One Belt One Road (OBOR) – CPEC

5. Land of Opportunities 4 hrs

a. Physical features: diversity and beauty

b. Natural resources – mineral, water, energy, agriculture & livestock, and marine resources

c. Tourism and Culture

6. Pakistan's Foreign Policy 5 hrs

a. Foreign Policy – Principles and Objectives
b. Relations with Neighbors
c. Major Economies
d. Muslim World
e. Geo-political and strategic significance of Pakistan in Regional and Global Politics

7. Pakistan in pursuit of Global Agenda 4 hrs

a. SDGs-2030 – Pakistan Goals
b. Commitments on Climate Change
c. Peace and Security

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Khalid B. Sayeed, Pakistan: The Formative Phase 1857 – 1948, Pakistan Publishing House, 1960
2. Gulam Allana, Quaid-e-Azam: the story of Pakistan, Ferozsons, 1967.
3. Shahid M. Amin, Pakistan's Foreign Policy: A Reappraisal, Oxford University Press, 2010.
4. S. Akbar Zaidi, Issues in Pakistan's economy, Oxford University Press, 2003.
5. Hamid Khan, Constitutional & political history of Pakistan, Oxford University Press, 2003
6. Rafi Raza, *Pakistan in Perspective 1947-1997*, Oxford University Press, 2003
7. Sharif-ul-Mujahid, *The Ideology of Pakistan* , Progressive Publishers, 1974.
8. Ziring Lawrence, *Pakistan in the Twentieth Century*, Oxford University Press, 1997 –
9. Burke S. M. & Ziring Lawrence, *Pakistan's Foreign Policy,* Oxford University Press, 1973. Mohammad Qadeer , Pakistan
10. Climate Change Policies-Ministry of Climate Change, Islamabad- http://mocc.gov.pk/
11. Sustainable Development Goals (SDGs)- www.pc.gov.web/sdg/sdgpak
12. Economic Survey of Pakistan- http://finance.gov.pk/survey_1617.html
13. Foreign Policies- Ministry of Foreign Affairs, Pakistan http://mofa.gov.pk/
14. Population Census of Pakistan- Economic Survey of Pakistan http://finance.gov.pk/survey_1617.html
15. Issues in Pakistan's Economy by S. Akbar Zaidi, ISBN: 0195790529.
16. Pakistan's Foreign Policy: A Reappraisal by Shahid M. Amin. ISBN: 0195798015
17. Newspapers editorial and selected journalistic writings on current affairs.
18. Pakistan (Lands, Peoples, & Cultures) by Carolyn Black, Bobbie Kalman. ISBN:

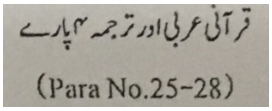
ARAB-252 Translation of the Holy Quran IV (1-0)

Contact Hours	**TRANSLATION OF THE HOLY QURAN IV**	**Credit Hours 1(1-0)**
Theory = 15 Practical = 0 Total = 15	**ARAB-252 | 4th Semester (B.Sc. Agricultural Engineering)**	Theory = 1.0 Practical = 0.0 Total = 1.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the basic beliefs of Islam, through the translation of Arabic texts of QURAN.	Cognitive	C1	PLO8 & PLO12	PEO3
CLO2	DISCUSS the Islamic civilization and culture, human rights in Islam, the lawful in Islamic sharia through the translation of Arabic texts of QURAN	Cognitive	C2	PLO6 & PLO12	PEO3



Year-3										
Fifth Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-301	Pumps and Tubewells	Engineering	Core Breath of Engg discipline		WK6	2(1-1)	1	1	2
2	FMP-301	IC Engines and Tractors	Engineering	Core Depth of Engg discipline		WK6	3(2-1)	2	1	3
3	FMP-303	Machine Design	Engineering	Core Depth of Engg discipline		WK5	3(2-1)	2	1	3
4	SEE-301	MDE Elective-I (Wastewater Engineering)	Engg.	Multi-disciplinary engineering courses (MDE)		WK4	3(2–1)	2	1	3
5	MAT-301	Probability and statistics	Non-Engineering	Natural Sciences	Mathematics	WK2	3(3-0)	3	0	3
6	SSH-301	Civics and Community Engagement	Non-Engineering	Humanities	Social Science	WK7	2(2-0)	2	0	2
7	ARAB-351	Translation of the Holy Quran V	Non-Engineering	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**14**	**4**	**16**

I&D-301 **Pumps and Tubewells** **2(1-1)**

Contact Hours Theory = 30 Practical = 45 Total = 75	**Pumps and Tubewells** **I&D-301 | 5th Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours** **3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the basic terminologies related to pumps and well hydraulics and RECOGNIZE the components of tubewells, pumps, and difference in their working principles	Cognitive	C2	PLO1	PEO1
CLO2	IMPLEMENT the fundamental concepts and formulae in the selection of suitable pumping system	Cognitive	C3	PLO2	PEO1
CLO3	DEMONSTRATE individually the selection criteria and the suitability of pumping system and tubewell flow measurement	Psychomotor	P3	PLO9	PEO2

Course outline:

1. Introduction

a. Functions of pumps and tubewells
b. Importance of pumps and tube wells in irrigation and drainage
c. Groundwater exploitation by tube wells Formulation

2. Well Hydraulics

a. Flow through porous media
b. Darcy's law
c. Aquifers and its types
d. Flow in confined and un-confined aquifers
e. Wells near aquifer boundaries
f. Multiple well system
g. Specific capacity
h. Well losses, Well efficiency
i. aquifer testing

3. Description of Tubewells

a. Components of a Tubewell
b. Factors affecting selection of site
c. Well drilling methods (percussion boring, straight and reverse rotary rigs)
d. Well design,

e. Well development methods
f. Skimming wells, Scavengers Wells

4. Pumps

a. Pump components
b. Pump classification; centrifugal, jet, positive displacement, turbine pumps, submersible pumps, propeller and mixed flow pumps and air lift pumps- Types of impellers.
c. Terminology in pumping systems- specific speed, priming, pumping energy, total dynamic head, pump problems and their remedies. Power requirement of pump

5. Characteristics of pump:

a. Specific speed
b. TDH-Q
c. BP-Q
d. NPSH-Q and Efficiency-Q curves
e. Cavitation
f. Net positive suction head(NPSH)
g. Affinity laws
h. Pump testing
i. Maintenance of pumps

6. Pump System Design and Power Requirements:

a. Suction lift
b. Delivery head
c. Friction head loss
d. Operating head-seasonal-variation in system head curve
e. Pump selection
f. Feasibility of prime mover selection

Practical:

- Study of components and operational characteristics of various pumps.
- Use of characteristic curves of different pumps.
- Design of a pumping well using field data.
- Design of gravel packing for specific conditions.
- Determination of pump efficiency
- Study of various components of tube well
- Discharge measurement of a tube well
- Measurement of drawdown caused by operational tube well

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Ahmad, N. 1995. Tube Well Theory and Practices, Shahzad Nazir Publisher, Gulberg-III, Lahore.
2. Colt Industries 1979. Hydraulic Handbook, 3601 Fairbank Avenue, Kanasa City, Kansas 661100, USA.
3. Hunt, T., and N. Vaughan, 1997. Hydraulic Handbook, 9thEdition, Elsevier Science;

4. Sterrett, R.J., 2007. Groundwater and Wells, Smyth Co. Inc.,USA.

FMP-301 IC Engines and Tractors 3(2-1)

Contact Hours Theory = 30 Practical = 45 Total = 75	**IC Engines and Tractors** **FMP-301 | 5th Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
1	DESCRIBE and explain the tractor power, its measurement, different processes and systems of tractors	Cognitive	C2	PLO1	PEO1
2	ANALYZE the engine troubles, their causes and remedies	Cognitive	C4	PLO2	PEO1
3	DEMONSTRATE the construction and working of different systems and components of a tractor as well as performing the servicing of IC engines and different tractor tests	Psychomotor	P4	PLO9	PEO2

Course Outlines:

1. Introduction
- a. History of engine development, engine cycles
- b. principles of operation, types of engines

2. Principal parts of engine
- a. Functions and construction
- b. Working mechanism

3. Fuels and combustion:
- a. Types and properties of engine fuels,
- b. Fuel tests and their significance, gasoline tests, antiknock test
- c. Engine emissions and their analysis

4. Fuel System:
- a. Major components of fuel systems (petrol/diesel),
- b. Fuel classification and storage
- c. Theory and mechanism carburetor
- d. Fuel injection pump, injector/nozzles, electronic fuel injection
- e. Governing system, calibration of fuel injection pump
- f. Trouble shooting of fuel system

5. Ignition system:
- a. Types of ignition, spark, magneto and compression ignition system

b. Induction coils, distributor, spark plug, contact-breaker points, condenser
c. Trouble shooting.

6. Cooling system:

a. Types, principle of operation, parts of air/water cooling system, line diagram
b. Radiator, thermostat, water pump, fan, engine heating, types of coolants
c. Repair and maintenance

7. Lubrication system:

a. Types of lubrication systems principle of operation
b. Components of lubrication systems, line diagram
c. Types of lubricants, trouble shootings and maintenance

8. Electrical System:

a. A.C. and D.C. voltage, alternator/dynamo,
b. Battery, battery charging and maintenance,
c. Self-starter, electrical gauges and controls, line diagram
d. Repair and maintenance of electrical system

9. Intake and exhaust system:

a. Air intake system, valve timing diagram,
b. Air cleaner, super charger, turbo charger, inter-cooling,
c. Construction of intake and exhaust manifolds, mufflers, flue gases

10. Mechanics of the Farm Tractor Chassis:

a. Kinematics and dynamics of tractor power applications,
b. Force Analysis, Soil reaction, Drawbar pull and traction mechanism,
c. Stability of tractors, Tipping and lateral stability.

11. Power Transmission System:

a. Clutch and Brakes, Transmission, Differentials, Power take-off
b. Pulley drives, Power lift and hydraulic controls
c. Tractors tests and performance

Practical:

- Demonstration of main components of engine and engine types.
- Demonstration of valve system and its adjustments.
- Demonstration of fuel system, cooling system and electrical system of tractor.
- Measurement of air pressure/air fuel ratio in each cylinder of engine.
- Fuel injector, pump adjustment and calibration.
- Demonstration of engine lubrication system.
- Servicing of a single cylinder diesel engine.
- Removal of air lock of a diesel engine.
- Battery testing for charging/discharging.
- Engine diagnostics-analysis of engine emissions using gas analyzer etc.
- Measurement of tractor PTO power.
- Tour to tractor industries.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Gupta, H.N., 2012. Fundamentals of internal combustion engines. PHI Learning Pvt. Ltd..
2. Powar, A. G. and V. V. Aware. 2007. Farm Machinery and Power. New India Publishing Agency, New Delhi, India.
3. Single, R.K. 2004. Internal Combustion Engines. S. K. Katana and Sons, Delhi, India.
4. S.C. Jain and C.R. Rai. 2000. Farm Tractor Maintenance and Repair, Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Halderman, J. C. D. Mitchell. 2005. Automotive Engines: theory and servicing. 5ed. Pearson Prentice Hall, Singapore.
6. Promersberger and Bishop. 1996. Farm Power. Prentice Hall Inc. Englewood Cliffs, New Jersey U.S.A
7. Paul W.G. James, H. Smith Jr and E. J. Ziruys. 1995. Fundamentals of Internal Combustion Engines, Ed. Oxford and IBH Publishing Company (Pvt) Ltd. New Delhi.

FMP-303 **Machine Design** **3(2-1)**

Contact Hours Theory = 30 Practical = 45 Total = 75	**MACHINE DESIGN** **FMP-303 | 5th Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	ANALYZE the standards and techniques used in design and analysis of machine elements like keys, couplings, brakes, clutches, fly wheels and screws.	Cognitive	C4	PLO1	PEO1
CLO2	EVALUATE appropriate solutions for machine design problems related to fastening and other elements.	Cognitive	C5	PLO2	PEO1
CLO3	DEMONSTRATE the ability to learn and select appropriate software for the design project and perform literature survey to contribute to lifelong learning.	Affective	A3	PLO5 PLO12	PEO3
CLO4	PERFORM the experiment following the demonstration and/or instruction using	Psychomotor	P3	PLO9	PEO2

	teamwork, interpersonal skills and professional growth.				

Course Outline:

1. Introduction:
- a. Mechanical Engineering Design,
- b. Safety and product reliability

2. Design considerations
- a. Phases of design
- b. Codes and standards, evaluation and presentation.

3. Design of shafts:
- a. Design of shafts, torsion of circular shafts,
- b. horsepower transmitted by the shafts,

4. Design of clutches
- a. Design procedure
- b. Numerical problems

5. Design of bearings
- a. Design procedure
- b. Numerical problems

6. Design of gears
- a. Design procedure
- b. Numerical problems

7. Design of flange
- a. Design procedure
- b. Numerical problems

8. Design of couplings
- a. Design procedure
- b. Numerical problems

9. Design of pulleys
- a. Design procedure
- b. Numerical problems

10. Design of connecting rods
- a. Design procedure
- b. Numerical problems

11. Design of Fasteners and Connections:
- a. Different types of fasteners, Thread standards and definitions
- b. Mechanics of power screws. Bolts strength and selection of units
- c. Bolt preload, torque requirement, Bolted
- d. Riveted and welded joints loaded in shear
- e. Keys pins, and retainers

12. Elements of Rotary Power Transmission:
- a. Belts, Stresses in belts, Chain and sprocket drives,
- b. Gears drives, Flexible shafts, Bearings

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Kalpakjian, S., S. Schmid. 2007. Manufacturing Processes for Engineering Materials. 5 Edition, Prentice Hall Publishers.
2. Blach, P.H. 2014. Machine Design. Edition, Tata-McGraw Publishing Company, New Delhi, India.
3. Shigley, J.E. and C. R. Mischhe, (2000). Mechanical Engineering Design. Fifth Edition. McGraw Hill Publications Inc. USA.
4. Parkinson, A.C. (1968). A First Year Engineering Drawing, sixth Ed., Sir Issac Pitman and Sons Ltd. London.
5. Spotts, M.F. (1978). Design of Machine Elements. Englewood Cliff Prentice Hall, London

SEE-301 **Wastewater Engineering** **3(2-1)**

Contact Hours	**WASTEWATER ENGINEERING**	**Credit Hours**
Theory = 30 Practical = 45 Total = 75	**SEE-301 | 5th Semester** **(B.Sc. Agricultural Engineering)**	**3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	IDENTIFY the parameters that characterize the constituents found in wastewater and their effect on treatment process selection	Cognitive	C2 Understanding	PLO 2 Problem Analysis	PEO1
CLO2	DEMONSTRATE the common physical, chemical and biological unit operations/processes encountered in treatment processes	Cognitive	C3 Applying	PLO1 Engineering Knowledge	PEO1
CLO3	ANALYZE design criteria necessary for the preparation of designs for wastewater treatment unit operations and processes.	Cognitive	C4 Analyzing	PLO4 Investigation	PEO2

CLO4	FORMULATE a preliminary design of a wastewater treatment plant.	Psychomotor	P4 Guided Response	PLO4 Investigation	PEO2

Course Outline:

1. Water Quality:
- a) Definitions and Terminology, Water Quality Indicators, key terms and Objectives
- b) Conventional and Emerging Water Pollutants and their Sources
- c) Drinking, Irrigation and Industrial Water Standards and Regulations (PEPA and WHO)
- d) Water Quality Status, Conveyance and Distribution Issues in Pakistan

2. Water Characteristics and Science
- a) Physical: Solids, Turbidity, Color, Taste and Odor, Temperature
- b) Chemical: pH, Total Dissolved Solids, Alkalinity, Hardness, Fluoride, Metals, Nutrients
- c) Biological: Bacteria, Viruses, Protozoa and other pathogens indicators
- d) Concepts of Water Cycle, Chemistry and Microbiology

3. Water Treatment Unit Operations and Processes
- a) Screening, Aeration, Sedimentation, Chemical Addition, Rapid and Slow Mixing, Flocculation, Filtration
- b) Coagulation, Neutralization, Disinfection, Fluoridation, Water Softening, Turbidity Removal, Re-carbonation, Disinfection, Taste and Odor Control
- c) Direct Filtration and Softening Water Treatment Plants

4. Advanced Water Treatment Processes
- a) Ion Exchange, Ozonation, Adsorption, Ultra Filtration
- b) Membrane Processes, UV and Ozone Disinfection

5. Wastewater Characteristics and Treatment
- a) Physical: Total Solids and Fractions (Suspended, Dissolved, Volatile and Fixed), Color, Temperature and Odor
- b) Chemical: pH, Dissolved Solids, COD and Fractions (particulate and dissolved), Alkalinity, Nutrients, Inorganics including Metals
- c) Biological: Biodegradable Organics, BOD fractions, microbial and pathogens indicators
- d) Terminologies and Definitions, Goals and levels of Wastewater Treatment
- e) Wastewater Treatment Regulations and Standards

6. Wastewater Collection and Treatment Processes
- a) Sewerage and Wastewater Collections Systems
- b) Physical Unit Operations, Chemical and Biological Unit Processes
- c) Preliminary Treatment: Screening, Shredding, Grit Removal, Pre-aeration, Equalization
- d) Sampling and Preliminary Treatment Process Control

7. Primary Wastewater Treatment (WWT)
- a) Sedimentation Process and Types of Sedimentation Tanks
- b) Clarifier loading and Process control,
- c) TSS and BOD Removal Performance, sludge pumping
- d) High rate and Chemically Enhanced Primary Treatment

8. Secondary Biological WWT
- a) Microorganisms and their role in wastewater treatment
- b) Types of biological processes for wastewater treatment
- c) Secondary Treatment Terminology and Process equipment

d) Bacterial Growth kinetics (Monod equation) and Process Modelling

9. Suspended and Attached Growth Biological Treatment Systems (Aerobic & Anaerobic)

a) Aerated Lagoons, Stabilization Ponds and Oxidation Ditches

b) Activated Sludge Process, Factors affecting, Modifications and Process Control

c) Sequencing Batch Reactors (SBR) and Up flow Anaerobic Sludge Blanket (UASB)

d) Trickling Filters and Packed-bed Reactors

e) Secondary Clarification and Plant Performance

10. Advanced Treatment systems

a) Chlorine Disinfection, Ozonation and UV irradiation

b) Chemical Treatment, Micro-screening, Filtration, Biological Nutrients Removal, Land Treatment and other options

11. Sludge Treatment and Disposal

a) Sludge Thickening and Conditioning

b) Sludge Stabilization (Aerobic and Anaerobic Digestion) and Dewatering

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Mackenzie L. Davis, Susan J, Masten 2014. Principles of Environmental Engineering and Science. McGraw Hill
2. Spellman, Frank R., 2003. Handbook of Water and Wastewater Treatment Plant Operations. Lewis Publishers. CRC Press Company, Boca Raton London New York Washington, D.C.
3. Metcalf and Eddy, 2013. Wastewater Engineering: Treatment and Reuse, 4th ed. McGraw Hill, ISBN: McGraw-Hill

MAT-301 **Probability and statistics** **3(3-0)**

Contact Hours	**PROBABILITY AND STATISTICS**	**Credit Hours 3(3-0)**
Theory = 45 Practical = 0 Total = 45	**MAT-301 | 5th Semester** **(B.Sc. Agricultural Engineering)**	Theory = 3.0 Practical = 0.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE and apply the basic concepts of probability	Cognitive	C2	PLO1	PEO1

	and statistics used for data representation and sampling				
CLO2	ANALYZE probability theory for data analysis in decision making and problem solving	Cognitive	C4	PLO4	PEO1
CLO3	EVALUATE different hypothesis tests for statistical significance	Cognitive	C5	PLO2	PEO2
CLO4	DEMONSTRATE the use of SPSS for statistical data analysis and probability theory	Cognitive	C2	PLO5	PEO3

Area Scope:

The knowledge units in this area collectively encompass the following:

- To Understand the basic concept of Statistics and Probability and their need in engineering.
- To Describe properties and classifications of probability density functions, regression analysis and interval estimation
- To Apply different probability and statistics techniques in engineering problems

Course Outline

- **Basic Statistics,**
  a. Statistics, Branches of Statistics, Importance of statistics, population, sample, observation, variables, measurement of variable, Data, primary data, secondary data
- **Data Presentation,**
  a. Frequency distribution (grouped, ungrouped), stem and leaf display, histogram, frequency polygon, cumulative frequency polygon, Simple & Multiple Bar diagrams
- **Measure of central tendency,**
  a. Arithmetic Mean (A.M), Geometric Mean (G.M), Harmonic Mean (H.M), Quantiles (Median, Quartiles, Deciles, Percentiles), Mode, Applications of Averages
- **Measure of Dispersion,**

a. Background, Range, Quartile deviation, Mean deviation, Variance, Standard deviation, Coefficient of variation, Moments, Moments ratios, Skewness, Kurtosis

b. Applications in different Engineering Disciplines

- **Simple Regression, Correlation and Curve fitting**
  a. Introduction to regression theory, Simple linear regression line, Line fitting by least square methods, Coefficient of determination,
  b. Simple correlation, coefficient of correlation, fitting of a first and second degree curve, fitting of exponential and logarithmic Curves, related problems.
  c. Principle of least squares.
- **Probability and random variables,**
  a. Probability review, Laws of probability, Conditional probability, Bayesian theorem, independent, dependent events.

b. Random variables, Discrete and Continuous random variables, Probability mass and density functions, Distribution functions, Mathematical expectation,

c. Variance of random variable, Bivariate distribution, Joint probability distribution, Moment generating function

- **Probability Distributions,**
  a. Discrete distributions:
  b. Bernoulli distribution, Binomial, Geometric, Negative binomial, Hyper-geometric, Poisson distribution, Properties and application of these distributions.
  c. Continuous Distributions: Uniform Distribution, Exponential distribution, Normal distribution, Applications
- **Sampling and Sampling Distributions**
  a. Introduction, Population, Parameter & Statistic, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors,
  b. Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem.
  c. Applications in relevant engineering discipline
- **Statistical Inference and Testing of Hypothesis,**
  a. Introduction to inferential statistics, Estimation, hypothesis testing of population mean, proportion,
  b. Variance, Applications in Engineering

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:
1. Introduction to Statistical theory part 1, by Sher Muhammad Chuadary (Latest Edition)
2. Advanced Engineering Mathematics, by Erwin Kreyszig (Latest Edition)
3. Probability and Statistics for Engineers

SSH-303 Civics and Community Engagement 2(2-0)

Contact Hours	**CIVICS AND COMMUNITY ENGAGEMENT**	**Credit Hours**
Theory = 30	**SSH301-301 | 5th Semester**	**2(2-0)**
Practical = 0	**(B.Sc. Agricultural Engineering)**	Theory = 2.0
Total = 30		Practical = 0.0
		Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)
Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	Analyze real-life social issues through their internship/attachment experience	Cognitive	C3	PLO10	PEO2
CLO2	Creative solutions to authentic problems relevant to the local, regional or the global community by integrating knowledge from a variety of disciplines	Psychomotor	P3	PLO10	PEO2
CLO1	Evaluate their internship/attachment experience and issues related to their personal and professional development.	Affective	A2	PLO8	PEO3

Area Scope:

This course aims to provide students with experiential learning opportunities to apply their knowledge and skills to tackle complex real-life problems in the community. Through first-hand practical experience and the project-based learning, students are guided to develop self-awareness of real-life issues, explore their career interests, workplace challenges, and reflect upon their life-career planning.

Course Outlines:

Students may choose to engage in either (1) internship to gain on-the-job experience by attaching to different kinds of organisations such as business firms, startups, NGOs, government agencies, consulates, etc., or (2) research attachment to involve in research/development/community projects led by Faculty members; or (3) other forms of student attachment or internship vetted by the Faculty. The internship/attachment is normally of at least 5 consecutive weeks full-time attachment during the summer or a minimum of 200 work hours during term time (or equivalent). Through first-hand practical experience and the project-based learning, students are guided to look in the major social issues/problems from their respective academic discipline as well as other relevant academic inputs from the instructor in the following areas:

1) Environmental and Urban Systems
   - Environmental Conservation and Sustainable Development
   - Urban Renewal
2) Populations and Well-being
   - Public Health • Child & Youth Development
   - Social Welfare • Education Needs
   - Ageing
   - Gender
   - Ethnicity and Equal Opportunities
   - Social Inequity • Human Rights
3) Learning, Praxis and Governance
   - Cultural Diversity
   - Heritage and Community Collective Memory
   - Political Governance
   - Other emerging social issues endorsed by Department/Faculty.

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

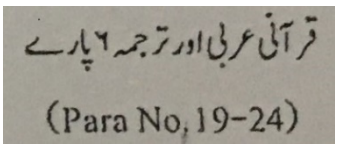
Suggested Books:
Taking the Communications High Ground, PAS Memo, March/April 2012, American Planning Association (Rooney, Hart, and Johnson)
Planning With Half a Mind: Why Planners Resist Emotion, Planning Theory and Practice 16(4):498-516 (Baum 2015)
Planners and the Digital Commons: Perspectives, Techniques, and Engagement, PAS Memo January/February 2014, American Planning Association (Shuler)
Using Online Tools for Public Engagement, PAS Quicknotes No. 51, American Planning Association (Read 2014)

ARAB-351 Translation of the Holy Quran V (1-0)

Contact Hours	**TRANSLATION OF THE HOLY QURAN V**	**Credit Hours**
Theory = 15	**ARAB-351 | 5th Semester**	**1(1-0)**
Practical = 0	**(B.Sc. Agricultural Engineering)**	Theory = 1.0
Total = 15		Practical = 0.0
		Total = 1.0

COURSE LEARNING OUTCOMES (CLOs)
Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the basic beliefs of Islam, through the translation of Arabic texts of QURAN.	Cognitive	C1	PLO8 & PLO12	PEO3
CLO2	DISCUSS the Islamic civilization and culture, human rights in Islam, the lawful in Islamic sharia through the translation of Arabic texts of QURAN	Cognitive	C2	PLO6 & PLO12	PEO3



Year-3										
Sixth Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-302	Engineering Hydrology	Engg.	Core Breadth of Engg discipline		WK4	3(2 – 1)	2	1	3
2	I&D-304	Irrigation Engineering	Engg.	Core Depth of Engg discipline		WK5	3(2 -1)	2	1	3
3	I&D-306	High Efficiency Irrigation Systems	Engg.	Core Breadth of Engg discipline		WK4	2(1-1)	1	1	2
4	FMP-302	Earth Moving Machinery	Engg.	Core Breadth of Engg discipline		WK4	2(1-1)	1	1	2
5	MSC-302	Management Elective-I (Engineering Project Management)	Non- Engg.	Management Science	Professional Practice	WK7	2(2-0)	2	0	2
6	MAT-304	Numerical Analysis	Non-Engineering	Natural Sciences	Mathematics	WK2	3(2-1)	2	1	3
7	SSH-302	Social Sci Elective-II (Economics for Engineers)	Non- Engg.	Humanities	Social Science	WK7	2(2-0)	2	0	2
8	ARAB-352	Translation of the Holy Quran VI	Non- Engg.	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**12**	**5**	**17**

I&D-302 **Engineering Hydrology** **3(2-1)**

Contact Hours Theory = 30 Practical = 45 Total = 75	**ENGINEERING HYDROLOGY** **I&D-302 | 6th Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN basic concepts of Engineering Hydrology	Cognitive	C2	PLO1	PEO1
CLO2	DEMONSTRATE measurement of various components of hydrological cycle	Cognitive	C3	PLO2	PEO1
CLO3	DEMONSTRATE experimental procedures to measure different hydrological quantities (precipitation, streamflow etc.)	Psychomotor	P3	PLO9	PEO2
CLO4	ANALYZE results of hydrological quantities using experimental data	Cognitive	C4	PLO2	PEO1

Course Outline:

Hydrologic processes:

Introduction, Hydrologic cycle and its components, importance of hydrology, climatic factors, estimation of precipitation, snow-cover and snow fall, stream flow, water stage, discharge, interpretation of stream flow data evaporation and transpiration, Evapotranspiration and its estimate using different methods.

Hydrologic Analysis:

Hydrograph and its characteristics, run off and its components, recessions, hydrograph separation, rainfall-runoff relations, phenomenon of runoff estimating the volume of storm runoff, estimating snow melt runoff, seasonal and annual runoff relations, hydrograph of runoff, unit hydrograph its derivation and application, overland flow.

Hydrologic routing:

Introduction, river routing, level pool routing, linear reservoir model, Muskingam method.

Hydrologic Models:

Definition, classification of models, development, calibration, verification and application of models.

Practical:

- Demonstration of weather recording instruments (at Weather Station) and practice in taking actual data from weather stations.
- Comparison of measured and predicted evapotranspiration
- Measuring runoff in the field by different techniques.
- Development of unit hydrograph and its use.
- Frequency analysis of rainfall data.
- Measuring infiltration rate in the field.

- Development of channel and flood routing for a given area

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Awan, N.M. 1981. Surface Water Hydrology, National Book Foundation, Islamabad.
2. Linsely, R.K., Kohler, J.L.H. Paulhyus 1996. Hydrology for Engineers, SI. Edition, McGraw Hill Kogakusha Ltd.
3. Ward, R.C., Robinson, and M. 1990. Principles of Hydrology, McGraw Hill Book Co., London.
4. Wilson, E. M. 1990. Engineering Hydrology, Macmillan Civil Engineering Hydraulics. N.Y.
5. Reddy, P.J.R., (2013). A textbook of Hydrology. University Science Press, India

I&D-304 Irrigation Engineering 3(2-1)

Contact Hours Theory = 30 Practical = 45 Total = 75	**IRRIGATION ENGINEERING** **I&D-304 | 6th Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	**EXPLAIN** various irrigation management concepts and impotence of irrigation with special reference to Pakistan resource and local conditions	Cognitive	C2 Understanding	PLO1 Engg. Know.	PEO1
CLO2	**SOLVE** problems regarding irrigation system design, issues and maintenance.	Cognitive	C3 Applying	PLO2 Prob. Analysis	PEO1
CLO3	**ANALYZE** physical parameters of irrigation structures using experimental data.	Cognitive	C4 Analyzing	PLO9 Indiv. and team work	PEO1
CLO4	**DEMONSTRATE** the use of softwares, collected meteorological/hydrological data, and laboratory tools for irrigation system design and management	Psychomotor	P3 Guided Response	PLO5 Mod. Tool Usage	PEO3

Course outline:

1. Introduction

a. History of Irrigation
b. Objectives of irrigation
c. Scope of Irrigation Engineering

2. Water resources for Irrigation

a. Irrigation system of Pakistan
b. Quantity and Quality of Rainfall, Surface Water and Groundwater
c. Water budget of Pakistan
d. Water Resources Issues and their solution
e. Water resource for hydro power

3. Water Law Doctrines

a. Transboundary Water Issues
b. Indus Water Treaty
c. Distribution of Indus River Water among the provinces
d. Water apportionment Accord

4. Warrabandi System

a. Objectives and types of Warrabandi System
b. Formulation of Warrabandi Schedule
c. Problems in Warrabandi System

5. Crop Water Requirements

a. crop period, base period, duty and delta, relationship between duty and delta, factors affecting duty, depth and frequencies of irrigation, Kharif-Rabi ratio, optimization of irrigation water,
b. irrigation efficiencies, uniformity coefficient,
c. consumptive use of water, effective rainfall,
d. net irrigation requirements, gross irrigation requirement,
e. estimation of consumption use, Blaney Criddle, Hargreaves Methods,

6. Irrigation System Management

a. Responsibilities and jurisdiction of institutes managing the water
b. Farmer's Organizations, Area Water Board (AWB)
c. assessment of irrigation water charges

7. Design of Irrigation Canal

a. Design of stable channel,
b. regime channels, Kennedy's theory, Lacey's theory,
c. estimation of transported sediment, bed load equations,
d. design procedure for unlined non-erodible irrigation channel,
e. maintenance of lined and unlined channels

8. Hydraulic Control Structures

a. Barrages, weirs, flow regulators, energy dissipaters
b. silt control structures in irrigations canals
c. Cross drainage structures
d. Canal falls
e. Flow Measuring structures (gauges, telemetry, stilling wells and others)

9. Dams/Small Structures

a. Classification of dams

b. Modes of failure
c. Stability analysis
d. Design of small/mini dam, outlets

Practical

- Study of characteristics of various irrigation structures in the nearby area.
- Design of irrigation outlet
- Discharge measurement through different types of outlets
- Design of irrigation canal using available software
- Design of a watercourse for a given command area (brick and PCPS lining)
- Sampling and measurement of sediments in canal water.
- A field visit to canal irrigation system and hydraulic structures.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Ali, I., 2003, Irrigation Engineering. Theory, Design and Practice. Oxford University Press, London.
2. Garg, S.K., 2009. Irrigation Engineering and Hydraulic Structures, Khanna Publishers
3. Michal, A.M. 2003, Irrigation Theory and Practice. Vikas Publishing House (Pvt) New Delhi, India. Arora,R.K.
4. Punmia, B.C., and Pande, B.B.L., 2016, Irrigation and Water Power Engineering, Published by Laxmi Publications (P) Ltd., New Delhi.
5. Siddiqui, I. H. 2003, Irrigation and Drainage Engineering, Royal Book Company, BG-Rex Centre Fatima Jinnah Road, Karachi.

&D-405 **Farm Irrigation Systems** **3(2-1)**

Contact Hours	**High Efficiency Irrigation Systems**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**I&D-306 | 6th Semester** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	**Describe** and **explain** the basic concepts of farm irrigation systems and its design components	Cognitive	C2	PLO1	PEO1

CLO2	**Apply** pertinent equations to design farm irrigation systems such as surface and pressurized irrigation	Cognitive	C3	PLO2	PEO2
CLO3	**Evaluate** the effectiveness of existing or newly designed irrigation system	Cognitive	C5	PLO4	PEO2
CLO4	**Conduct** and **Execute** different experiments to determine required data for irrigation system design	Psychomotor	P4	PLO9	PEO2

Course outline:

1. History of Irrigation:

a. Scope of Irrigation in Pakistan

b. Farm Irrigation Systems

2. Systems Design Fundamentals:

a. Functions of farm irrigation systems

b. Types of farm irrigation systems

c. Conveyance methods

d. Design of farm irrigation systems

e. Data for design

f. Water source evaluation

g. Determination of daily design requirements

3. Crop Water Requirements:

a. Pan Evaporation Method

b. Blaney Criddle Method

c. Hargreaves and Samani equation

d. FAO Radiation

e. FAO Blaney–Criddle Method

f. Penman Monteith Method

g. Jansen Haise Method

h. Modified Penman Monteith Method (Cropwat Model),

i. Water Balance Approach

j. Crop Coefficients, Evapotranspiration,

4. Plant-Water-Soil Relationship:

a. Infiltration Measurement Methods

b. Green and Ampt Model

c. Horton’s Equation

d. Kostiakov Method

e. Richard’s Equation

f. Double Ring Infiltrometer Test

g. Total Soil Moisture Potential

h. Soil Moisture Retention Curves

i. Soil Moisture Measurement Methods

j. Soil Analysis

k. Sieve Analysis, Pressure Membrane Apparatus.

5. Design of HEIS Irrigation:

a. History and Scope in Pakistan
b. Components of Trickle irrigation system
c. Head Unit
d.Filtration system requirement for HEIS
e. Fertigation system for HEIS
f. Design of Trickle Irrigation System for different crops

76. Sprinkle Irrigation System:

a. Types of sprinkler system
b.Components of sprinkler system
c. Pressure requirement of Sprinkler irrigation
d.Design of Sprinkler Irrigation System

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Allen, R.G., Pereira, L.S, Raes, D. and Smith, M. 1998. Crop evapotranspiration (Guidelines for computing crop water requirements), FAO Irrigation and Drainage Paper 56, Rome, Italy.
2. Laffan J. 2016, Irrigation: Centre Pivot and Lateral move. NSW Agriculture, Australia.
3. Laycock A. 2007. Irrigation Systems: Design, Planning and Construction. CABI.UK
4. Majumdar D.K., 2013, Irrigation Water Management: Principles and Practices. Prentice-Hall ofIndia.
5. OFWM. 1991. OFWM Field Manual 1-4, Federal Water Management Cell. Ministry ofFood, Agriculture and Livestock, Islamabad,Pakistan.
6. Tripathi N. 2014. Irrigation, Watershed and Drainage. Agrotech Press, India.

FMP-302 Earth Moving Machinery 2(1-1)

Contact Hours	**Earth Moving Machinery**	**Credit Hours**
Theory = 15 Practical = 45 Total = 60	**FMP- 302 | 6th Semester** **(B.Sc. Agricultural Engineering)**	**2(1-1)** Theory = 1.0 Practical = 1.0 Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
1	DESCRIBE and EXPLAIN Farm mechanization, earth moving machines,	Cognitive	C3	PLO1	PEO1

	their working principles, their design parameters, mechanics of tillage and hitching of farm implement				
2	PERFORM the evaluation of different farming activities involving farm and earth moving machines/ implement and perform the cost analysis of different farm machines and activities	Cognitive	C4	PLO4	PEO2
3	DEMONSTRATION and calibration of different farm machines	Psychomotor	P4	PLO9	PEO3

Course Outline:

1. Field Capacities and Cost Analysis:

a. Implements Types, Factors affecting field capacity

b. Cost analysis

2. Hydraulics Controls

a. Components of a hydraulic system, Types of hydraulic system

b. Single, Parallel and Series cylinder systems, Limit control

c. Automatic position and Draft control

3. Power Drives

a. Hydrostatic Propulsion drives, PTO drives using two universal joints,

b. Three- joints PTO drives, Loads imposed on P.T.O. shafts,

c. Recommended PTO load limits

4. Agricultural field machinery and systems

a. Principles of operation, design and selection,

b. Testing and evaluation of Functional and mechanical performances

5. Tillage Force Analysis

a. Forces acting upon a tillage implement

b. Mechanics of tillage, Tillage tool design factors

c. Measuring and evaluating performance, Measuring draft of implements

6. Hitching

a. Vertical and horizontal hitching of trailed implement,

b. Hitches for mounted implements,

c. Depth and draft control on hitches.

d. Crop and soil interaction with machines.

7. Primary Tillage Implements:

a. Function and Types of Mold board plows

b. Components of a mold board plow, Reaction of soils to mold boards

c. Pulverizing action, Turning and inversion, Scouring

d. Forces acting upon a plow bottom

e. Effects of soil types, depth of plowing shape and design,

f. attachments and rear furrow wheel and speed on draft and performance.

g. Functions, components and types of Disk plows, Rotary plows, Chisel and subsurface plows.

8. Secondary Tillage Implements:

a. Functions, components and types of Harrows, Cultivators

b. Land rollers and Pulverizers
c. Subsurface tillage tools and field cultivators

9. Equipment for Sowing and Planting:

a. Functions, components and types of planting equipment,
b. Seed metering devices, Maize drills,
c. Calibration of seed drill.
d. Broadcasting machines, Fertilizer and insecticide placement.
e. Transplanting machines, Spraying systems

10. Grain and Seed Harvesting:

a. Harvesting and threshing methods,
b. Types and development of Combines, functional elements of a combine,
c. Flow path of material, Types and sources of seed loss,
d. Types of threshing cylinders, Threshing effectiveness, Cylinder adjustment,
e. Testing of Combines and its power requirements, Windrowing

11. Earth Moving Equipment:

a. Principles and working of Bulldozers,
b. Soil scrapers and ditchers, Crawler,
c. Parts of Crawler,
d. Comparison of wheel type and Crawler tractors

Practical:

- Identification of Primary Tillage Implements.
- Identification of Secondary Tillage Implements.
- Determination of Field Capacity and Field Efficiency of Agricultural Field Implements under actual field condition.
- Determination of Tractor Wheel Slip.
- Measurement of Power Requirement of Cultivator, MB Plow and Subsoiler
- Measurement of Power Requirement of Rotavator, Disk Harrow and Grain Drill
- Calibration of grain drills.
- Field Evaluation of Combine Harvester and Wheat Thresher.
- Study and operation of Tractor Hydraulic System.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Kepner, R. A., R. Bainer and E. L. Barger. 2005. Principles of Farm Machinery. 3rd Edition, AVI Publishing Company, Inc. Westport, USA.
2. Haycraft W. R. – 2002. The Story of the Earthmoving Equipment Industry. Library of Congress cataloging .USA

3. Smith H. P. and L. H. Wilkes. (1976). Farm Machinery and Equipment, 6th Ed. McGraw-Hill, Inc. USA
4. RNAM Test Codes and Procedures for Farm Machinery, 1995 Economic and Social Commission for Asia and the Pacific Regional Network for Agricultural Machinery, Second Edition C/o UN-EXCAP UN Building, Rajadamnern Nok Avenue, Bangkok, Thailand.

MSC-302 Engineering Project Management 2(2-0)

Contact Hours Theory = 0 Practical = 90 Total = 90	**ENGINEERING PROJECT MANAGEMENT** **MSC- 302 | 6th Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 2(0-2)** Theory = 0 Practical = 2.0 Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DEFINE the basic terms in engineering project management, project costing, budgeting, and financial appraisal	Cognitive	C2 Understanding	PLO11	PEO1
CLO2	DEMONSTRATE the use of computers in Project Management, especially a tool like MS Project & Primavera etc.	Cognitive	C3	PLO5	PEO3
CLO3	GAIN exposure to project Planning Control and Management, using standard tools and schedule variance analysis	Psychomotor	P3 Guided Response	PLO11	PEO2

Area Scope:

The primary objective of this course is to get the fair understanding of core issues pertaining to Engineering Project Management. This course is aimed at providing both basic and some advanced exposure to emerging trends in the field of Project Management, so as to enable the engineering professionals of tomorrow to successfully complete sophisticated projects within the constraints of capital, time, and other resources with due regards to stakeholders set of expectations. Engineering students will learn key Project Management skills and strategies and will be able to face emerging challenges.

Core Objectives of this course are:

- To develop competencies in project costing, budgeting, and financial appraisal;
- To gain exposure to project Planning Control and Management, using standard tools and schedule variance analysis;

- To appreciate the elements of risk and quality in hi-tech projects;
- To learn Project Management by "practice", through the medium of "End of Semester Group Project"; and
- To appreciate and understand the use of computers in Project Management, especially a tool like MS Project & Primavera etc.

Course Outline:

- **Project Management Concepts**

History of Project Management, Introduction to Project Management, Project, Program & Portfolio Management, Project characteristics, Objectives& Requirements, Project Phases/Stages, Project Life Cycle, Project Environment, Project Scope & Project Charter, Project Manager, Project Stakeholder Analysis.

- **Project Proposal Development**

Project Proposal, Characteristics of good proposal, Types of Proposals, Request for Proposal, Request for Quotation etc). Proposal Templates etc.

- **Project Feasibility**

Brief review of various aspects of Project Feasibility like Technical, Social, Managerial, Economic, Financial & Marketing, Administrative etc.

- **Project Selection Criteria (Economic Analysis of Engineering Projects)**

Using Break Even Analysis, Cost Benefit Ratio, Internal Rate of Return, Net Present Value etc.

- Project Contract & Procurement Management

Engineering contracts, Type of contracts, understanding of procurement Process & Cycle, PPRA Rules

- **Project Planning and Scheduling**
- Project Planning (Resource & HR Planning), Work Breakdown Structure, Project Network & Scheduling, Manning Schedule and Activity Charts, Critical Path Method (CPM)/Project Evaluation & Review Techniques
- **Project Costing & Estimation**

Cost Estimation in Projects, Cost components in projects and methods for cost estimation in projects, Cost Control in Projects, Estimation of Outstanding Work, Earned Value Management, Schedule & cost variance analysis

- **Project HRM & Communication Management**

Effective organization and communication for Successful Projects, Project Organizational Structures (Project matrix and project based organizations), Project HR Plan preparation, HR Need Assessment and HR Matrix, Building and Managing effective project team, Selection & control mechanism of HRM in Projects, Effective Communication Plan.

- **Project Risk Management**

Definitions Project Risk, Project Risk Management Tools, Types of Project Risk, Project Risk Assessment, Risk Identification and Mitigation, Monitoring & Controlling Risk, Generic Risk Management Strategies & Technique.

- **Computer Application in Project Management**

Basic/Elementary Introduction and hands on basic exposure of use of MS Project & Primavera P6 Software in Project Management

- **Project Quality Management**

- Defining Quality, Quality Assurance, Quality Management, 7 Quality Improvement Tools as applied to Project Management, Project Quality Management Plan, Quality Management Processes and Strategies
- **Project Closure & Termination**

Project Evaluation, defining project success, Project Completion Criteria, Project Audit, Project Termination &When to close a project, the termination process, Project Close Up & lesson learnt, & Project Archive

Teaching Methodology (Proposed as applicable))

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

References Books

1. Project Management: A system Approach to Planning, Scheduling and Controlling 11th Edition, Harold Kerzner
2. Bennett, F. Lawrence. 1996. *The management of engineering*. New York: Wiley.
3. Cleland, David. *Field guide to project management.* New York: Wiley.
4. Eisner, H. *Essentials of project management and systems engineering management*. New York: Wiley.
5. Frame, J. D. *Managing projects in organizations*. San Francisco: Jossey-Bass
6. Goldratt, Eliyahu. *Critical* chain. North River Press.
7. Haynes, M.E. *Project management: From idea to implementation*. Los Altos, CA: Crisp Publications.
8. Lewis, James, *Project planning, scheduling & control*. New York: McGraw-Hill
9. Lewis, James, P. 1998. *Mastering project management*. New York: McGraw-Hill
10. Lientz, Bennet & Rea, Kathryn. 1995. *Project management for the 21st century*. San Diego: Academic Press.
11. Miller, Roger & Lessard, Donald. 2000. *The strategic management of large engineering projects.* Cambridge, MA: MIT Press.
12. Nicholas, J.M. *Managing business & engineering projects*. Englewood Cliffs, NJ: Prentice Hall.
13. Shtub, Avraham, Bard, Jonathan, & Globerson, Shlomo. 1994. *Project management: Engineering, technology, and implementation.* Englewood Cliffs, Prentice-Hall.
14. Project Management by Adrienne Watt
15. J.R. Meredith and S.J. Mantel. Project Management: A Managerial Approach. John Wiley and Sons. New York. 2019. (Reference).

MAT-304 **Numerical Analysis** **2(2-0)**

Contact Hours Theory = 30 Practical = 45 Total = 75	**NUMERICAL ANALYSIS** **MAT-304 | 6th Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 2(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE different numerical techniques in interpolation, differentiation, integration, eigenvalues and solution of algebraic and differential equations	Cognitive	C2	PLO1	PEO1
CLO2	ANALYZE and interpret solutions obtained via numerical methods such as intial value problems, finite difference method	Cognitive	C4	PLO2	PEO1
CLO3	DEMOSTRATE flowchart development for formulating numerical solution through advance tools.	Cognitive	C2	PLO2	PEO2
CLO4	DEMONSTRATE Matlab/VBA codes for advance and efficient numerical solutions	Cognitive	C3	PLO5	PEO2

Area Scope:

The knowledge units in this area collectively encompass the following:

- To comprehend different numerical techniques such as: error propagation, interpolation, differentiation, integration, eigenvalues and solution of algebraic and differential equations
- To apply the numerical techniques to different linear and nonlinear engineering problems

Course Outline

- **Error Analysis and Interpolation**
  - **a.** Error analysis, Types of error, Sources of error, Norms of vectors and matrices, Computer arithmetic, Condition number of a matrix, Significant digits and loss of significant digits, Floating point arithmetic, Binary and decimal representation, Single and double precision
  - **b.** Interpolation: Newton forward and backward difference formula for interpolation, Central difference interpolation formulae, Lagrange's interpolation, Error in interpolation, Linear least square approximation, Interpolation versus least square approximation, Relevant engineering case studies
- **Numerical Differentiation and Integration**

a. Derivation of numerical differentiation of first order and second order derivatives using two points, three points, and five points formulas along with its application in engineering, Relevant case studies

b. Numerical integration: Trapezoidal rule, Simpson's rules, Composite Trapezoidal Simpson Rules and Romberg integration, Applications of numerical in engineering, Relevant case studies

- **Methods of solution a system of Linear Equations**
  - **a.** Solution of system of linear algebraic equations, Gauss elimination method
  - **b.** LU factorization, Tridiagonal solver
  - **c.** Applications of these methods in engineering disciplines, Relevant case studies
- **Iterative Methods for Linear and Nonlinear Equations**
  - **a.** Numerical Solution of nonlinear equations: Bisection method, Newton's method, Secant method, Convergence analysis of these methods
  - **b.** Newton's method for system of nonlinear equations
  - **c.** Solution of system of linear equations by Jacobi, Gauss Seidel and SOR methods, Applications of these methods in engineering disciplines, Relevant case studies
- **Numerical Methods for IVPs and BVPs**
  - **a.** Euler's method and its variations, Taylor's higher order methods, Error analysis, Consistency, stability and convergence
  - **b.** Runge-Kutta methods of order 2, 3, and 4, Stiff ODEs, Consistency, stability and convergence
  - **c.** Linear multistep methods, Numerical solution of system of ODEs
  - **d.** Numerical solution of BVPs by Finite Difference Method
  - **e.** Applications in engineering: Some relevant case studies
- **Numerical Methods for Computing Eigenvalues**
  - **a.** Eigenvalues and Eigenvectors of matrix: power method,
  - **b.** Inverse power method, Shifted inverse power method.
  - **c.** Applications of eigenvalues in engineering disciplines.
- **Numerical Optimization**
  - **a.** Unconstrained Optimization,
  - **b.** Golden search ratio, Lagrange Multipliers,
  - **c.** Method of steepest descent
  - **d.** Applications of optimization in engineering disciplines

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Numerical Analysis: By Richard L. Burden, J. Douglas Faires, Latest Edition
2. Numerical methods for scientist and engineers by R.W. Hamming (Latest Edition)
3. Numerical methods for Engineers by Steven C. Chapra and R. P. Canale (Latest Edition)

SSH-302 Economics for Engineers 2(2-0)

Contact Hours Theory = 30 Practical = 0 Total = 30	**ECONOMICS FOR ENGINEERS** **SSH-302 | 6th Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 2(2-0)** Theory = 2.0 Practical = 0.0 Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN the basic knowledge of engineering economics and conventions.	Cognitive	C2	PLO6	PEO3
CLO2	EXPLAIN the cost effectiveness of individual engineering projects using the methods learned and draw inferences for the investment decisions.	Cognitive	C2	PLO11	PEO3

Area Scope:

- Apply the appropriate engineering economics analysis method(s) for problem solving i.e. present worth, annual cost, rate of return, payback, break-even, benefit-cost ratio
- Evaluate the cost effectiveness of individual projects using the methods learnt, draw inferences for investment decisions, and compare the life cycle cost of multiple projects.
- Compute the depreciation of an asset using standard depreciation techniques to assess its impact on present or future value

Course outline

Engineering Economics

- Role of engineers in business
- Economic decisions v/s design decisions
- Large scale engineering projects and types of strategic economic decisions
- Fundamental principles of engineering economics

Interest Rate and Economic Equivalence

- Interest: The Cost of Money
- Economic Equivalence
- Development of Formulas for Equivalence Calculation
- Unconventional Equivalence Calculations

Understanding Money and Its Management

- Nominal and Effective Interest Rates
- Equivalence Calculations with Effective Interest Rates and with Continuous Payments
- Changing Interest Rates
- Debt Management
- Investing in Financial Assets

Present-Worth Analysis

- Project Cash Flows

- Initial Project Screening Methods: payback Screening and Discounted Cash Flow Analysis
- Variations of Present-Worth Analysis
- Comparing Mutually Exclusive Alternatives

Annual Equivalent-Worth Analysis Annual Equivalent-Worth Criterion

- Capital Costs versus Operating Costs
- Applying Annual-Worth Analysis
- Life-Cycle Cost Analysis
- Design Economics

Rate-of-Return Analysis

- Rate of Return and Methods of Finding It
- Internal Rate-of-Return Criterion
- Mutually Exclusive Alternatives

Cost Concepts Relevant to Decision Making

- General Cost Terms; Classifying Costs for Financial Statements
- Cost Classifications for Predicting Cost Behavior
- Future Costs for Business Decisions
- Estimating Profit from Production

Depreciation and Corporate Taxes

- Asset Depreciation: Economic versus Accounting
- Book and Tax Depreciation Methods (MACRS)
- Depletion
- Income Tax Rate to be used in Economic Analysis
- The Need for cash Flow in Engineering Economic Analysis

Developing Project Cash Flows

- Cost-Benefit Estimation for Engineering Projects
- Developing Cash Flow Statements

Project Risk and Uncertainty

- Origins of Project Risk
- Methods of Describing Project Risk: Sensitivity, Break-Even and Scenario Analysis

Special Topics in Engineering Economics

- Replacement Decisions
- Capital Budgeting Decisions
- Economic Analysis in the Service Sector

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Contemporary Engineering Economics by Chan S. Park, 6th edition, Pearson 2015, ISBN: 9780134105598
2. Engineering Economic Analysis by Donal G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, 12th edition, Oxford University Press, ISBN: 978-0199339273
3. Engineering Economy by Leland T. Blank and Anthony Tarquin

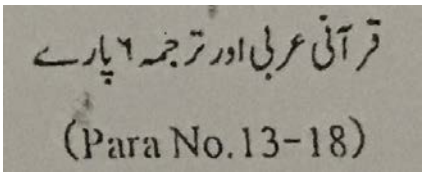
ARAB-352 **Translation of the Holy Quran VI** **1(1-0)**

Contact Hours	**TRANSLATION OF THE HOLY QURAN VI**	**Credit Hours**
Theory = 15 Practical = 0 Total = 15	**ARAB-352 | 6th Semester** **(B.Sc. Agricultural Engineering)**	**1(1-0)** Theory = 1.0 Practical = 0.0 Total = 1.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the basic beliefs of Islam, through the translation of Arabic texts of QURAN.	Cognitive	C1	PLO8 & PLO12	PEO3
CLO2	DISCUSS the Islamic civilization and culture, human rights in Islam, the lawful in Islamic sharia through the translation of Arabic texts of QURAN	Cognitive	C2	PLO6 & PLO12	PEO3



Year-4										
Seventh Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-401	GIS & Remote Sensing	Engineering	Computer and Information Science	ICT/AI/Data Sciences/ Cyber Security	WK4	3(2-1)	2	1	3
2	SEE-401	Solid Waste Engineering	Engineering	Core Breadth of Engg discipline		WK4	3(2–1)	2	1	3
3	FMP-401	Agricultural Process Engineering	Engineering	Core Breadth of Engg discipline		WK4	3(2-1)	2	1	3
4	FMP-403	Farm Machinery and Automation	Engineering	Core Depth of Engg discipline		WK6	2(2-1)	2	1	3
5	I&D/SEE-FMP-	Engg Elective-I	Engineering	Core Breadth of Engg discipline		WK4	3(1-1)	1	1	2
6	AEN-401	Final Year Design Project (FYDP)-I	Engineering	Final Year Design Project (FYDP) Capstone	Industrial/ Innovative/ Creative Project	WK8	3(0-3)	0	3	3
7	MSC-401	Management Elective-II (Entrepreneurship)	Non-Engineering	Management Sciences	Professional Practice	WK7	2(2-0)	2	0	2
8	ARAB-451	Translation of the Holy Quran VII	Non-Engineering	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**11**	**8**	**19**

I&D-401 **GIS & Remote Sensing** **2(1-1)**

COURSE LEARNING OUTCOMS (CLOs)
Upon successful Competition of the Course, the student will be able to:

I&D-401 **GIS and Remote Sensing** **3(2-1)**

Contact Hours Theory = 15 Practical = 45 Total = 60	**GIS AND REMOTE SENSING** **I&D-401 |7th Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours** **2(1-1)** Theory = 1.0 Practical = 1.0 Total = 2.0

Course Learning Outcomes (CLOs) and CLO Mapping
COURSE LEARNING OUTCOMS (CLOs)
Upon successful Competition of the Course, the student will be able to:

CLO	Statement	Learning Domain	Taxonomy Level	PLO	PEO
CLO-1	EXPLAIN fundamental concepts of Remote Sensing and GIS	Cognitive	C2	PLO1	PEO1
CLO-2	APPLY different sources of data, process of creating data, data quality	Cognitive	C3	PLO 4	PEO1
CLO-3	DEMONSTRATE related software for analysis and design	Psychomotor	P2	PLO 5	PEO2

Couse Outlines

1. Introduction to GIS
- a. Backgrounds and basic concept
- b. Scope and application area
- c. Mapping concept
- d. Map types
- e. Map elements and scales, f. Mapping process

2. Fundamentals of GIS
- a. Types of datasets
- b. Formats of datasets
- c. Functional elements of GIS
- d. Spatial data models
- e. Raster and vector data structures
- f. Inter-conversion of raster and vector data structures

3. Introduction to Remote Sensing
- a. Concept of RS technology
- b. RS datatypesp

c. Satellite systems and sensors
d. GPS and DGPS
e. Spectral signatures

4. Spatial and Attribute Database Development

a. Data query
b. Attribute data handling
c. Vector databased development
d. Vectorization process
e. Flat file description
f. Spatial and attribute data linking
g. Database management

5. Data Manipulation and Analysis

a. Soil Geoprocessing Techniques
b. Interpolation using geostatistics
c. Reclassification technique
d. Creating continuous surfaces from point data, global methods
e. Creating continuous surfaces from point data, local methods
f. Pixel sampling &Quantization

6. Introduction to Remote Sensing Image

a. Image interpretation process (elements and strategies)
b. Image processing techniques(data import, Geometric correction)
c. Image interpretation & GPS technique: Visual and digital interpretation
d. Global Positioning System (GPS) technique and process
e. Image classification: Hybrid technique of image classification
f. Supervised and unsupervised techniques

7. Remote Sensing Analysis

a. Land cover/Landuse classification and monitoring
b. Ground truthing and field verification
c. Integration of RS and GIS techniques, Landcover change detection
d. Digital Elevation Model (DEM)techniques
e. Topographic feature extraction and application\
f. Digital Elevation Model utilization in watershed / Basin modelling
g. Integration of DEM in GIS (Visualization and Mapping)

8. Natural Resources Management using Satellite Imagery

a. Introduction to remotely sensed crop, soil, land and water information
b. Normalized Difference Vegetation Index(NDVI)
c. Normalized Difference Water Index (NDWI)
d. Normalized Difference Built-up Index(NDBI)
e. Normalized Difference Snow Index (NDSI)
f. Moisture Stress Index (MSI)
g. Relationships between radiations and earth features
h. Time series crop health monitoring using vegetation indices

Practical:

- GIS software's overview
- Linking spatial and non-spatial database
- database editing and updating

- GPS data integration in GIS
- Data manipulation and preprocessing
- Spatial analysis
- Map generation
- Charting and tabular representation
- Image processing software – overview
- Global Mapper Overview

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Barrett, E.C. and Curtis, L.F. 2014. Introduction to Environmental Remote Sensing, 4th Edition, Chapman and Hall, London.
2. Foody, G. and Gurran, P. 1994. Environmental Remote Sensing from Regional to Global Scales. John Willey and Sons, England.
3. Heywood, I., Cornelius, S., and S. Carver 2012. An introduction to geographical information systems, 4th Edition, Illustrated Published by Pearson Prentice Hall.
4. Keith, C.C., Bradley O. Parts and Michael P.C. 2004. Geographic Information Systems and Environmental Modeling.
5. McCoy, R. M., 2005. Field methods in remote sensing, Published by Guilford Press, ISBN 1593850794, 9781593850791 Manual of Remote Sensing.

**** The course contents, ClOs and associated mapping is updated by Board of Studies of Agricultural Engineering in its meeting held on 26th May 2022**

SEE-401 Solid Waste Engineering 3(2-1)**

Contact Hours Theory = 30 Practical = 45 Total = 75	**SOLID WASTE ENGINEERING** **SEE-401 |7th Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours** **3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

Course Learning Outcomes (CLOs) and CLO Mapping

Upon successful completion of the course, the student will be able to:

CLO	Statement	Learning Domain	PLO	PEO
CLO1	**Understand** the sources, composition and characteristics of the solid waste	**Cog-2** Understanding	**PLO1** Engineering Knowledge	1
CLO2	**Analyzing** the solid waste management systems with respect to its properties, and associated critical considerations in view of emerging technologies	**Cog-4** Analyzing	**PLO7** Environment and sustainability	3
CLO3	**Select** the appropriate method for solid waste collection, transportation, redistribution and disposal	**Cog-5** Evaluating	**PLO4** Investigation	2

CLO4	**Plan/Design** a solid waste management plan	**Psy-3** Guided Response	**PLO9** Individual & teamwork	2

Course Outline

Solid Waste

a) Sources and types of wastes
b) Composition and generation rates
c) Bio-chemical properties of Wastes
d) Some typical wastes
e) Identification of various agricultural wastes

Integrated Solid Waste Management

a) Solid waste in history
   a. Legislation and regulation
b) Materials flow (Segregation, Reduction, Reuse, Recycling, Recovery, Disposal, Energy conversion)
c) Need of integrated solid waste management
d) Municipal solid waste characteristics

Recycling and Management

a) Recycling of wastes, plastics, batteries and e-waste
b) By products of cereals, legumes, oil seeds, fruits and vegetables
c) Crop, livestock and aquatic waste utilization in various industries
d) Fermentation of by-products and waste
e) Furnaces and boilers run on agricultural wastes and by-products
f) Green House Gas emission and emission modeling
g) Generation of electricity using surplus biomass/energy recovery

Solid Waste Management Strategies

a) Study and operation of equipment used for size reduction
b) Mechanical-biological treatment, Digesting and processing of
c) Study and operation of equipment/machines used for utilizing various wastes
d) Composting , Incineration and Landfill process and design
e) Study of techniques for bio-gas production utilizing plant and animal waste
f) Utilization of agricultural wastes for production of manure and animal feed

Processing of Municipal Solid Waste (MSW)

a) Storing, Conveying, Compacting, Shredding, Pulping, roll crushing and granulating
b) Material Separation (Screens, Float Separators, Magnet and electrochemical separators, Materials separation systems)

Combustion and Energy Recovery

a) Heat value of refuse (Proximate, Ultimate, colorimetry and component analysis)
b) Materials and thermal balances
c) Combustion and incineration for MSW

Biochemical Processes

d) Methane generation by anaerobic digestion
e) Composting
f) Other biochemical processes

Current issues in Solid waste Management

a) Life cycle analysis and management
b) Financing solid waste facilities(annual cost, percent worth, sinking funds, capital plus O&M cost
c) Hazardous Waste Management
d) Emerging techniques/technologies for Solid waste Management

Practical:

a) Proximate and Ultimate analysis of solid waste
b) Componential analysis of solid waste
c) Determination of moisture content of solid waste
d) Determination of Particle size distribution of solid waste
e) Determination of bulk and material density of solid waste
f) Determination of biodegradability of solid waste
g) Determination of calorific value of solid waste
h) Visit to solid waste management sites
i) Use of computer software used for solid waste management and their quantitative analysis
j) Solid waste management experts visits

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Recommended Books:

1) Wang, L.K., Wang, M.H.S. and Hung, Y.T., 2021. "Solid Waste Engineering and Management". Springer Nature Switzerland, Switzerland.
2) P aarne, V., 2022. "Solid Waste Engineering".
3) Worrell, W.A., and Vesilind, P.A., 2011. "Solid Waste Engineering". Cengage Learning.
4) Gottinger, H.W., 2018. "Economic models and applications of solid waste management". Routledge.
5) Worrell, W.A., Vesilind, P.A. and Ludwig, C., 2016. "Solid waste engineering: a global perspective". Nelson Education.

FMP-401 Agricultural Process Engineering 3(2-1)

Contact Hours	**AGRICULTURAL PROCESS ENGINEERING**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**FMP-401 | 7th Semester** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the importance of agricultural processing for value addition and EXPLAIN the different unit operations involved in it.	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO2	CHOOSE the suitable equipment for various agricultural processing operations.	Cognitive	C3 Applying	PLO4 Investigation	PEO1
CLO3	CATEGORIZE the shelf-life enhancement techniques for	Psychomotor	P3 Guided Response	PLO3 Design/Dev. of solutions	PEO2

	different agricultural products.				

Course Outline:

1. Introduction

a. Importance of Agricultural Process Engineering for value addition,
b. Structure and composition of food grains and fruits,
c. Physical, mechanical and thermal properties of agricultural materials

2. Fans

a. Classification as to type and design of fans, fan theory,
b. Fan performance, factors affecting fan selection,
c. General performance and laws, fans in series and parallel, compression effect.

3. Material handling and transportation equipment

a. Belt conveyors, chain conveyors
b. Pneumatic conveyors, gravity conveyors
c. Bucket elevators augers, trailer/ trucks

4. Cleaning, Sorting and grading

a. Grade factors, washing types and methods of washing
b. Sorting fruits and vegetables, types of sorters, cleaning and sorting
c. Grading, nuts and seeds, types of grain cleaners/sorter
d. Aerodynamics of small particles, types of separators
e. Machine vision and its applications in grading

5. Size reduction

a. Types of size reduction mills, fineness modulus,
b. Value of ground feed, size relationships, energy requirements
c. Size reduction procedures, reducing devices
d. Performance and characteristics of size reduction devices
e. Mixing and types of mixers

6. Cold Storages

a. Need of cold storages, types of cold storages and their design
b. Temperature and humidity controls, heat load
c. Automation of cold storages
d. Air conditioning, aeration, storage temperatures for various horticultural produce

7. Drying

a. Drying and dehydration
b. Moisture content determinations; primary methods, equilibrium moisture content,
c. Drying processes, constant rate period, falling rate period, falling rate drying mechanism,
d. Dynamics of equilibrium moisture content, effect of temperature upon the rate of drying,
e. Effect of air rate upon the rate of drying, heat and mass balance limitation of the drying
f. Equipment, types of driers psychometric chart, calculations
g. Design of drying systems using computer simulation.

8. Milling and Extraction

a. Grain handling systems. Corn wet and dry milling.
b. Rice milling. Extraction of Canola and Cottonseed oils.

9. Packaging Material

a. Packaging materials and techniques,
b. Material properties, packing geometries.

Practical:

- Determination of internal friction and angle of repose
- Measurement of bulk density of grains
- Measurement of grain moisture content by oven method and moisture meter.
- Selection of fans for aeration and drying of grains
- Demonstration of sieves used for cleaning/grading
- Demonstration of sieve and length graders, spiral seed separator
- Demonstration of rise husker and rice polishing machine
- Study of Psychometric chart to calculate heat transfer during aeration/drying.
- Study of dehydration characteristics of fruits/vegetable by moisture content vs time curve and drying rate vs moisture content curve.
- Visit to cold storage facilities.
- Study tour to visit agricultural processing units and plants.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Henderson, S.M. 2010. Agricultural Process Engineering. The AVI Publishing Company, Inc. Westport, Connecticut. USA.
2. Dabhi, M.N. and N.K. Dhamsaniya. 2008. Agricultural Process Engineering. Agrotech Publishing Academy, India.
3. Toledo, R.T. 2006. Fundamentals of Food Process Engineering. Food Science Text Series.
4. Pandey, H. H. K. Sharma, R. C. Chauhan, B. C. Sarkar and M. B. Bera. 2004. Experiments in food process engineering. CBS Publishers and distributors, New Delhi, India
5. Sahay, K. M. and K. K. Singh. 2002. Unit operation of agricultural processing. 2 Ed. Vikas Publishing House, New Delhi, India.
6. Hanlon, J. F. 1992. Handbook of packaging engineering. 2nd Ed. John Willey and Sons, N.Y., USA
7. Henderson, S.M. 1986. Agricultural Process Engineering. The AVI Publishing Company, Inc. Westport. USA.

FMP-403 **Farm Machinery and Automation** **3(2-1)**

Contact Hours Theory = 30 Practical = 45 Total = 75	**FARM MACHINERY AND AUTOMATION** **FMP-403 | 7th Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN the status of fam mechanization and policy options for optimum mechanization.	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO2	DEMONSTRATE the working principles and design of planting, sowing, plant protection, harvesting machinery and Precision Farm machinery utilization	Cognitive	C3 Applying	PLO1 Engineering Knowledge	PEO1
CLO3	ANALYSIS of farm machinery performance	Cognitive	C4 Analyzing	PLO1 Engineering Knowledge	PEO1
CLO4	PERFORM the experiments relating to farm machinery performance and design evaluation	Psychomotor	P4	PLO9 Individual and Teamwork	PEO2

Course outlines:

Mechanization

- o History of mechanization
- o Objectives, constraints, and policy measure

Equipment for sowing and planting

- o Functions, components and types of planting equipment,
- o Seed metering devices, maize drills,
- o Calibration of seed drill.
- O Broadcasting machines,
- o Transplanting machines,
- o Sugar cane planter etc.
- · Equipment for plant protection (5 hours)
- o Chemical plant protection,
- o Mechanical plant protection,
- o Dry chemical application equipment,
- o Liquid chemical application equipment,
- o Boom sprayer parts and working,

o Calibration of boom sprayer, nozzles and their types, precision sprayers.
· Grain and seed harvesting (8 hours)
o Harvesting methods, reaper, mower, sugar cane harvester, cotton picker, corn/maize harvester, thresher,
o Types of threshing cylinders, threshing effectiveness, cylinder adjustment,
o Types and development of combines, functional elements of a combine, flow path of material,
o Types and sources of seed loss,
o Testing of combines and its power requirements.
· Field capacities and cost analysis (3 hours)
o Field capacity, factors affecting field capacity, thorough put capacity,
o Cost analysis, fixed cost, variable cost.
· Precision agriculture equipment (8 hours)
o Introduction and utilization of direct rice drill,
o Rice trans-planter,
o Pneumatic seed drill, narrow seed drill,
o Precision planters
o Thematic mapper for soil analysis,
o Variable rate sprayer,
o Drones usage in precision agriculture.
O Auto-steering technology

Practical:

Identification of Primary Tillage Implements.

- Identification of Secondary Tillage Implements.
- Determination of Field Capacity of Agricultural Field Implements under actual field condition.
- Determination of Field Efficiency of Agricultural Field Implements.
- Determination of tractor Wheel Slip.
- Calibration of grain drills in Laboratory.
- Calibration of grain drills in Field.
- Study and operation of Tractor Hydraulic System.
- Mini Project.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:

Mid Term, Report writing/Presentation, Assignments, Quizzes, Design Projects, Complex Problems, Final Term

Suggested Books:

1. Haddock, K. 2017. Modern Earthmoving Machines, Enthusiast Books, Sofia, Bulgaria.
2. Haycraft, W. R. 2002. The Story of the Earthmoving Equipment Industry. Library of Congress cataloging, USA.
3. Mehta, M. L., S. R. Verma and S. K. Mishra. 2016.Testing and Evaluation of Agricultural Machinery, DAYA Publishing House, New Dehli India.
4. Singh, T.P. 2016. Farm Machinery, PHI Learning Private Limited, Dehli, India.

AEN-401 **Final Year Design Project (FYDP)-I** **3(0-3)**

Contact Hours Theory = 0 Practical = 45 Total = 45	**FINAL YEAR DESIGN PROJECT (FYDP)-I** **AEN-401 | 7th Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 3(0-1)** Theory = 0.0 Practical = 1.0 Total = 1.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESIGN solution for a complex engineering problem using systematic approach	Cognitive	C5	PLO3	PEO1
CLO2	EVALUATE the outcomes of the design, analyse, and interpret data and make useful conclusion	Cognitive	C6	PLO4	PEO1
CLO3	UTILIZE modern tools and techniques to accomplish the solution of the design project	Psychomotor	P5	PLO5	PEO1
CLO4	CONSIDER societal, health, safety, legal and cultural issues while undertaking solution for the design project.	Affective	A4	PLO6	PEO3
CLO5	SUSTAINABILITY considerations while undertaking solution for the design project	Affective	A3	PLO7	PEO3
CLO6	MAINTAIN highest level of ethical and professional norms in pursuing the design project	Affective	A4	PLO8	PEO3
CLO7	COORDINATE with the team members such that the individual tasks build up into a consolidated solution of the design project	Affective	A3	PLO9	PEO2
CLO8	DEMONSTRATE effective oral and written communication through presentations, written reports and demonstrations.	Affective	A4	PLO10	PEO2
CLO9	EXECUTE the design project by meeting deadlines and managing resources in an optimal way	Affective	A4	PLO11	PEO2
CLO10	CORRELATE the complex engineering problem solution with the futuristic developments and opportunities	Affective	A4	PLO12	PEO3

The Final Year Project (FYP) is assigned to solve a "Complex Engineering Problem (CEP)" in 7th Semester based on the knowledge and skills gained by the students, which continues in 8th Semester. The aim of the FYP is to provide each student the opportunity to learn the engineering design and development process in the context of a topic related to the curriculum.
The FYP is intended to acquire the following knowledge and skills:

- Selection/Preparation of:
- research topic (problem identification)
- objectives
- review of literature
- methodology
- data analysis and results
- conclusions and recommendations
- Preparation of Technical Report (Thesis):
- Life-Long Learning

Recommended Books:

1. Kothari, C. R. (2004). *Research Methodology: Methods and Techniques.* 2nd Revised Edition, New Age International Pvt. Ltd. Publishers, India.

MSC-401 Entrepreneurship 2(2-0)

Contact Hours Theory = 30 Practical = 0 Total = 30	**ENTREPRENEURSHIP** **MSC-401 | 7th Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 2(2-0)** Theory = 2.0 Practical = 0.0 Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN the basic concept of entrepreneurship , concept generation, market analyses for product and development of business plan	Cognitive	C2	PLO11	PEO1
CLO2	EXPLAIN the intellectual rights, Financial and Legal Modalities	Cognitive	C4	PLO6	PEO2
CLO3	DEMONSTRATE the case study of successful business plan and their critical analysis	Cognitive	C5	PLO11	PEO3

Area Scope:

- Develop a business plan with an appropriate business model
- Demonstrate the ability to provide a self-analysis in the context of an entrepreneurial
- career
- Demonstrate the ability to find an attractive market that can be reached economically

Course Outlines

1. Basic Concept-Entrepreneurship
2. Innovation and Entrepreneurship
3. Basic Plan Development Cycle
4. Intellectual Rights
5. Financial and Legal Modalities
6. Marketing
7. Industrial Competiveness
8. Gap Analysis, Critical Thinking and Idea Generation
9. Business Plan Development
10. Successful Case Studies (local)

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Michael J Etzel, Bruce J Walker, William J Stanton, Marketing, McGraw-Hill 2010
2. William D. Bygrave and Andrew Zacharak, Entrepreneurship 2nd Edition, Wiley, 2012.
3. Entrepreneurship by Hisrich, McGraw- Hill, 2009
4. Principles of Marketing, Cotrell McGraw- Hill 2012
5. Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship
6. P.N. Singh: Entrepreneurship for Economic Growth
7. Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker
8. John B. Miner: Entrepreneurial Success
9. “Marketing that Works: How Entrepreneurial Marketing Can Add Sustainable Value to Any Sized Company”, by Leonard Lodish, Howard Morgan, Shellye Archambeau and Jeffrey Babin, Pearson FT Press
10. “Entrepreneurial Marketing,” Lessons from Wharton’s Pioneering MBA Course, Morgan, H. L., A. Kallianpur, and L. M. Lodish, John Wiley & Sons, 2001

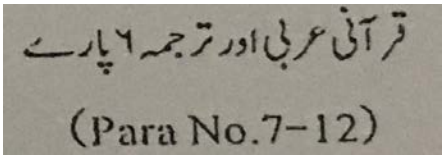
ARAB-451 **Translation of the Holy Quran VII** **1(1-0)**

Contact Hours Theory = 15 Practical = 0 Total = 15	**TRANSLATION OF THE HOLY QURAN VIII** **ARAB-451 | 7th Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 1(1-0)** Theory = 1.0 Practical = 0.0 Total = 1.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the basic beliefs of Islam, through the translation of Arabic texts of QURAN.	Cognitive	C1	PLO8 & PLO12	PEO3
CLO2	DISCUSS the Islamic civilization and culture, human rights in Islam, the lawful in Islamic sharia through the translation of Arabic texts of QURAN	Cognitive	C2	PLO6 & PLO12	PEO3



Year-4										
Eighth Semester										
Sr. No.	**Course Code**	**Title**	**Domain**	**Knowledge Area**	**Knowledge Sub-Area**	**Knowledge Profile (WK)**	**Credit Hour**	**Theory**	**Lab**	**Total**
1	I&D-402	Drainage Engineering	Engineering	Core Depth of Engg discipline		WK5	3(2-1)	2	1	3
2	SEE-402	Farm Structures and Control Sheds	Engineering	Core Breath of Engg discipline		WK5	3(2-1)	2	1	3
3	FMP-402	MDE Elective-II (Alternate and Renewable Energy (ARE))	Engineering	Multi-disciplinary engineering courses (MDE)		WK4	2(1–1)	1	1	2
4	I&D/SEE/ FMP-	Engg. Elective-II	Engineering	Core Depth of Engg discipline		WK4	3(2-1)	2	1	3
5	I&D/SEE/ FMP-	Engg. Elective-III	Engineering	Core Depth of Engg discipline		WK4	3(2-1)	2	1	3
6	AEN-402	Final Year Design Project (FYDP) - II	Engineering	Final Year Design Project (FYDP)/ Capstone	Industrial/ Innovative/ Creative Project	WK8	3(0-3)	0	3	3
7	ARAB-452	Translation of the Holy Quran VIII	Non-Engineering	Humanities	Culture	WK7	1(1-0)	Non-Credit Hour Course**		
Total								**9**	**8**	**17**

I&D-402 **Drainage Engineering**

3(2-1)

Contact Hours	**DRAINAGE ENGINEERING**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**I&D-402 | 8th Semester** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	**DESCRIBE** basic drainage terms, its concepts and dicussion of local drainage issues	Cognitive	C2 Understanding	PLO1 Engg. Know.	PEO1
CLO2	**DEMOSTRATE** application of drainage theory on different drainage design	Cognitive	C3 Applying	PLO2 Prob. Analysis	PEO1
CLO3	**ANALYZE** soil workability conditions under different watertable depths using DRAINMOD	Cognitive	C4 Analyzing	PLO4 Investigation	PEO2
CLO4	**DEMONSTRATE** working principles, installation process, operation and maintenance mechanisms of different drainage system and observation wells.	Psychomotor	P3 Guided Response	PLO9 Indiv. and team work	PEO3

Outline:

- **Introduction**
  - Definition, sources, history and adverse effects of agricultural drainage
  - Salient features of drainage projects in Pakistan
  - Desirable water table depth, Ground water table depth and crop yields
  - Identification of drainage problems, Solution of the drainage problems,
  - Comparison of different drainage systems
- **Soil Water Relations**
  - Soil hydraulic characteristics (types, pores spaces, water pressure distribution in the soil profile, Surface tension, capillary pressure, Saturated, Unsaturated hydraulic conductivity, Drainable pore space)
  - Soil moisture retention curves
- **Waterloging and Salinity**
  - Accumulation of salts at the soil surface
  - Type of Salinity
  - Treatment procedures
- **Theories of Sub-Surface pipe drainage**

- Theory of ground water flow to drains,
- Steady state drainage design,
- Drainage system design equations (Hooghoudt equation, Partial penetration of drains, Kirkham solution, Ernst Equation, Donan equation, Modified Donan equation, Drainage design for anisotropic soils, Van beers formula, Drainage of artesian pressure, Unsteady state drainage equation, Glove-Dumm formula, De zeeuw-helinga model

- **Sub-Surface Horizontal Drainage System**
  - Design, Construction and Operation, Drains system's layout
  - Drain pipe, Pipe envelop
  - Gravel envelope design, Synthetic envelop design, Placement of envelop materials
  - Tile drainage system
  - Construction of pipe drain system
  - Drainage machinery
  - Pipe installation below the water table
  - Drainage structures
  - checking performance of pipe drainage systems, clogging of drain pipe, slots and envelop
  - Pipe cleaning (operation and maintenance issues)
  - Effluent disposal and re-use
- **Surface Drainage System Design:**
  - Design variables and parameters BP-Q
  - General procedure for drain design
  - Drain alignment/location
  - Drain design discharge
  - Hydraulic grade line and hydraulic gradient
  - Permissible flow velocities
  - Drain structures, Operation and maintenance of drains
- **Vertical Drainage System:**
  - Drainage mechanism
  - Tubewells and groundwater drainage
  - Advantages of tubewell drainage
  - Drainage coefficient for well drainage
  - Tubewell size selection
  - Number of pumping tubewells
  - Tubewell layout,
  - Effluent disposal
- **Operation and Maintenance of Drainage System:**
  - Buried Pipe drainage system
  - open drainage system
  - drainage water disposal ponds
  - drainage observation well
  - policy and basic requirements, weed control and embankment stability.

PRACTICAL:

- Determination of depth to water table and Contouring

- Saturated Hydraulic Conductivity by Auger hole method, reverse auger hole, piezometer,
- Drawing of soil moisture retention curves of a given soil
- Estimation of parameters of van Genuchten Model
- Gravel pack filter design using sieve analysis method
- Measurement of seepage losses
- Design of a sump for pipe drainage systems
- Visit of Drainage Projects.
- Computation of leaching requirement
- Computation of drainage coefficient of a drainage basin.
- Application of available drainage software (Hydrus, WM-Subsurface Software, Drain)

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Ghosh, S.N., 2006. Flood Control and Drainage Engineering, 3rdEdition by Publisher Taylor and Francis
2. Siddique, I. 2009. Irrigation and Drainage Engineering. A Oxford University Press
3. Waller, P. and M. Yitayew. 2016. Irrigation and Drainage Engineering. CBS Publishers, New Delhi, India
4. Tariq, Ata-ur-Rehman,2012: Drainage Systems Engineering. Centre of Excellence in Water Resources Engineering, University of Engineering & Technology, Lahore

SEE-402 Farm Structures and Control Sheds 3(2-1)

Contact Hours Theory = 30 Practical = 45 Total = 75	**FARM STRUCTURES AND CONTROL SHEDS** **SEE-402 | 8th Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the farmstead including the requirements for dairy, poultry, and storage buildings	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO2	DEMONSTRATE the farm bridges, roads, fences, green houses, gates, and feedlot equipment	Cognitive	C3 Applying	PLO4 Investigation	PEO1

CLO3	PERFORM design and cost estimation of farm service buildings	Psychomotor	P4 Mechanism	PLO3 Design/Dev. of solutions	PEO2

Course Outline:

1. Introduction: Definition and types of farm service buildings, structural materials and their uses.
2. Farm Stead: Definition, site selection developing a farmstead plan, arrangement of farmstead buildings
3. Farm building design: Planning the farm homes, dairy cattle housing, poultry housing, sheep housing, care and maintenance of farm buildings.
4. Dairy Building: Functional planning, Environment, Sanitation, Space requirements for animals and traffic, arrangement of space, Other considerations, Milking Parlors, Pen vs Stall Barns, Storage or feed, Milk and manure etc, Insulation and ventilation, Design of Dairy Building.
5. Poultry Housing: Functional planning, Production practices, Environment, Space requirements, Arrangement or space, Insulation and ventilation, other considerations, Design of Poultry House.
6. Storage: Characteristics of grains, fibre, fruits and vegetables, structural requirements for them, economics aspects of farm buildings and structures.
7. Estimating and Costing, Need for Estimation and Costing, Procedure of Estimating or Method of Estimating, Data required to prepare an Estimate, Drawings, Specifications, Rates, Complete Estimate, Measurement of Materials & Works, Types of Estimates, Detailed estimate, Data, Methods of Preparation of Approximate Estimation, estimation of quantities of steel & RCC elements
8. Farm bridges, and roads, fences, green houses, gates, feed lot equipment and animal handling equipment.

Practical:

1. To draw the layout plan of old and new agricultural engineering workshop.
2. Different materials used in farm structure their properties and their requirement.
3. To draw the layout plan of dairy farm and its requirements.
4. To draw the layout plan of horse farm and its requirement.
5. To draw the layout plan of poultry farm and its requirement.
6. Design problems of farm structures and godowns.
7. Numerical problems related to capacity of farms, size of farm.
8. Numerical problems related to agricultural processing.
9. Design problems of grain storage structures.
10. Storage of milk and its processing at dairy farm and numerical problems related to it.
11. Animal shelters in farm their types and size according to the size of animal.
12. Cost estimation of farms.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Barre, H. J., and Sommet, L. L. Farm Structure. John Wiley and Sons., Inc, New York, USA.
2. Barnes, Amaurice M. and Mander Clive, 2000. Farm Building Construction. Farming Press, England
3. Gray Horrold, E. 1985. Farm Service Building. McGraw-Hill Book Company, New York
4. Neubauer, L.W. and Walker H.B. 1981. Farm Building Design. Prentice Hall Inc., Englewood Cliffs, N.J.Haider, S.Z. 1985. Materials of Construction. Oxford University Press, Pakistan

FMP-402 Alternate and Renewable Energy 2(1-1)

Contact Hours	**ALTERNATE AND RENEWABLE ENERGY**	**Credit Hours**
Theory = 15	**FMP-402 | 8th Semester**	**2(1-1)**
Practical = 45	**(B.Sc. Agricultural Engineering)**	Theory = 1.0
Total = 60		Practical = 1.0
		Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DEFINE the renewable and non-renewable energy sources and their relative contribution to the global and national energy budget.	Cognitive	C1 Remembering	PLO1 Engineering Knowledge	PEO1
CLO2	EXPLAIN the renewable energy resources available in the country.	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO3	ANALYZE the numerical problems related to solar, biogas, wind energy, and hydroelectricity.	Psychomotor	P2 Set	PLO2 Problem Analysis	PEO2

Course outline:

1. History of energy usage, forms of energy, present energy consumption, environmental problems, Current status of conventional and renewable energy sources: World and Pakistan scenario, energy and power;
2. Fossil Fuel Resources (Oil, Gas, Coal)

3. Solar thermal energy: a. Solar radiation resource, b. Passive and active solar heating c. Solar concentrators
4. Solar photovoltaic: a. Components of PV systems and operation
5. Biomass

a. Biomass resource, b. Extracting biomass energy, c. Fuel crops, d. Anaerobic digestion, e. Landfill gas, f. Waste to energy

6. Hydroelectricity

a. Hydro power Resource, b. Hydropower power equation, c. Introduction to turbines, d. Large and small scales systems, e. Pumped storage, f. Tidal Power, g. The tides, tidal resource, system operation, environmental factors

7. Wind energy

a. Generation of the winds, b. Wind resource, c. Basic aerodynamics (lift versus drag) and the fundamental power equation, d. Fundamental design concepts.

8. Wave energy

a. The wave resource, b. The fundamental power equation, c. Onshore and off-shore wave energy extraction systems

9. Geothermal Energy

a. Nature of fields, b. Classification of Geothermal Resources, c. Introduction to geothermal steam electric plants, d. Liquid Dominated System: Flashed Steam System, Total Flow Concept, Geothermal exploration.

10. Fuel Cell

a. Introduction and Classification, b. Reactions and Configurations

11. Nuclear Energy

Practical:

- Estimation of energy requirements for major crops.
- Design and performance evaluation of biogas plants
- Estimation of solar and wind energies
- Performance measurement of different solar dryers
- Performance/evaluation of wind mills
- Energy audit of irrigation tube wells
- Measurement of energy contents in diesel, biomass, and vegetable oil with calorimeter.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Duffie, J.A. and W.A. Beckman. 2013. Solar Engineering of Thermal Processes, 3rd Edition, John Wiley & Sons.
2. Boyle, G. Renewable Energy: Power for a Sustainable Future. 2nd Edition, OUP and Open University, 2004, ISBN 019926178-4.
3. Boyle, G., B. Everett, and J. Ramage. 2003. Energy Systems and Sustainability, OUP and Open University, 2004, ISBN-13: 9780199261796.
4. Scheer, H., A Solar Manifesto, James & James, 2004, ISBN 1 902916 24 7.

5. Kalogirou, S.A. 2009. Solar Energy Engineering: Processes and Systems. 1st Ed. British Library. ISBN 978-0-12-374501-9. Printed in USA.
6. B. Viswanathan, M. Aulice Scibioh. 2007. Fuel Cells: Principles and Applications. Taylor & Francis Group, 2007.

AEN-402 Final Year Design Project (FYDP)-II 3(0-3)

Contact Hours Theory = 0 Practical = 45 Total = 45	**FINAL YEAR DESIGN PROJECT (FYDP)-II** **AEN-402 | 8th Semester (B.Sc. Agricultural Engineering)**	**Credit Hours 3(0-1)** Theory = 0.0 Practical = 1.0 Total = 1.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESIGN solution for a complex engineering problem using systematic approach	Cognitive	C5	PLO3	PEO1
CLO2	EVALUATE the outcomes of the design, analyse, and interpret data and make useful conclusion	Cognitive	C6	PLO4	PEO1
CLO3	UTILIZE modern tools and techniques to accomplish the solution of the design project	Psychomotor	P5	PLO5	PEO1
CLO4	CONSIDER societal, health, safety, legal and cultural issues while undertaking solution for the design project.	Affective	A4	PLO6	PEO3
CLO5	SUSTAINABILITY considerations while undertaking solution for the design project	Affective	A3	PLO7	PEO3
CLO6	MAINTAIN highest level of ethical and professional norms in pursuing the design project	Affective	A4	PLO8	PEO3
CLO7	COORDINATE with the team members such that the individual tasks build up into a consolidated solution of the design project	Affective	A3	PLO9	PEO2
CLO8	DEMONSTRATE effective oral and written communication through presentations, written reports and demonstrations.	Affective	A4	PLO10	PEO2
CLO9	EXECUTE the design project by meeting deadlines and managing resources in an optimal way	Affective	A4	PLO11	PEO2

CLO10	CORRELATE the complex engineering problem solution with the futuristic developments and opportunities	Affective	A4	PLO12	PEO3

The Final Year Project (FYP) is assigned to solve a "Complex Engineering Problem (CEP)" in 7th Semester based on the knowledge and skills gained by the students, which continues in 8th Semester. The aim of the FYP is to provide each student the opportunity to learn the engineering design and development process in the context of a topic related to the curriculum.

The FYP is intended to acquire the following knowledge and skills:

- Selection/Preparation of:
- research topic (problem identification)
- objectives
- review of literature
- methodology
- data analysis and results
- conclusions and recommendations
- Preparation of Technical Report (Thesis):
- Life-Long Learning

Recommended Books:

1. Kothari, C. R. (2004). *Research Methodology: Methods and Techniques.* 2nd Revised Edition, New Age International Pvt. Ltd. Publishers, India.

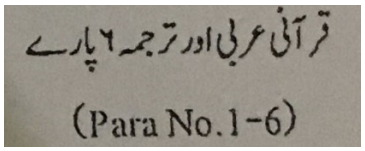
ARAB-452 Translation of the Holy Quran VII I 1(1-0)

Contact Hours Theory = 15 Practical = 0 Total = 15	**TRANSLATION OF THE HOLY QURAN VIII** **ARAB-452 | 8th Semester** **(B.Sc. Agricultural Engineering)**	**Credit Hours 1(1-0)** Theory = 1.0 Practical = 0.0 Total = 1.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the basic beliefs of Islam, through the translation of Arabic texts of QURAN.	Cognitive	C1	PLO8 & PLO12	PEO3
CLO2	DISCUSS the Islamic civilization and culture, human rights in Islam, the lawful in Islamic sharia through the translation of Arabic texts of QURAN	Cognitive	C2	PLO6 & PLO12	PEO3



13.2 Elective Courses for Water Resources Engineering

Course ID	Course Title	Cr. Hrs	Theory	Prac.	Total
I&D-403	Soil and Water Conservation Engineering	3(2-1)	2	1	3
I&D-404	Farm Water Management	3(2-1)	2	1	3
I&D-405	Farm Irrigation Systems	3(2–1)	2	1	3
I&D-406	Groundwater Hydrology	3(2-1)	2	1	3
I&D-407	Irrigation Water Management Techniques	3(2-1)	2	1	3
I&D-408	Soil Dynamics	3(2-1)	2	1	3
I&D-409	Water Resources Assessment and Management	3(2-1)	2	1	3

I&D-403 Soil and Water Conservation Engineering
3(2-1)

Contact Hours	SOIL & WATER CONSERVATION ENGINEERING	Credit Hours 3(2-1)
Theory = 30 Practical = 45 Total = 75	**I&D-403 | ELECTIVE** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN the process of wind and water erosions including soil degradation and its protection	Cognitive	C2	PLO1	PEO1
CLO2	ANALYZE factors affecting runoff including rainfall intensity, duration and infiltration rate; and their combined effect on flood generation to explore an integrated strategy for rain and flood water harvesting	Cognitive	C4	PLO2	PEO1
CLO3	IDENTIFY the relevant Cropping System and Agronomic Measures for Erosion Control and Watershed management viz; Plant cover, Crop rotation, Strip-	Cognitive	C3	PLO2	PEO2

	cropping, etc.				
CLO4	EVALUATE the use of vegetated outlets, field terraces, farm ponds and water harvesting techniques in the control of erosion.	Psychomotor	P4	PLO3	PEO2

Course outline:

1. Introduction to Soil and Water Conservation

a. Soil and Water Conservation
b. Types of erosion
c. Effects and importance

2. Water Erosion

a. Erosion agents
b. Geologic and accelerated erosion
c. Damages caused by soil erosion
d. Water erosion and its types
e. Factors affecting water erosion
f. Sedimentation and pollution in relation to water erosion
g. Water erosion prediction equation
h. Erosion control practices

3. Wind Erosion

a. Factors affecting wind erosion
b. Types of soil movement
c. Mechanics of wind erosion
d. Wind erosion control principles
e. Wind erosion prediction equation

4. Rainfall and Runoff

a. Rainfall intensity and duration
b. Infiltration
c. Factors affecting runoff
d. Damages caused by floods
e. Water harvesting

5. Cropping System and Agronomic Measures for Erosion Control

a. Watershed management
b. Plant cover
c. Crop rotation
d. Strip-cropping
e. Conservation tillage
f. Contour cultivation
g. Land capability classification

6. Terracing

a. Field terrace
b. Classification of terraces
c. Broad base terraces
d. Bench terraces
e. Terrace design
f. Planning the terrace system

g. Terrace construction and maintenance

7. Vegetated Outlets

a. Use of vegetated outlets and water courses in the control of erosion

b. Design of vegetated outlets

c. Water-way construction and maintenance

8. Conservation Structures

a. Drops Spillways

b. Chutes and Pipes Spillways; their requirements, components and limitations

9. Water Conservation

a. Definition of drought

b. Effects of drought

c. Water stored in soil

d. Decreasing runoff

e. Reducing evaporation

f. Reducing deep percolation

g. Preventing losses from storage

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Practical:

- Measurements of soil loss from splash erosion by rainfall simulator
- Measurements of soil loss using universal soil loss equation
- Demonstration of moisture conservation techniques
- Performance measurement of water harvesting techniques
- Field visit to areas with water and wind erosion prevailing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Linsely, R.K. and Franzini, Joseph. 1996. Water Resources Engineering. McGrawHill. FAO.
2. Schwab G. O., D.D Fangmeier, W. J. Elliot and R. K. Frevert. (2002). Soil and Water Conservation Engineering, 4th edition. John Wiley and Sons, N.Y.
3. Suresh, R. 2012. *Soil and water conservation engineering*, Standard publishers Distributors, 1705-B Nai Sarak, Delhi, India.

I&D-404 **Farm Water Management**
3(2-1)

Contact Hours	Farm Water Management I&D- 404 | ELECTIVE (B.Sc. Agricultural Engineering)	Credit Hours
Theory = 15 **Practical = 45** **Total = 60**		**3(2-1)** **Theory = 2.0** **Practical =1.0** **Total =3.0**

COURSE LEARNING OUTCOMS (CLOs)
Upon successful Competition of the Course, the student will be able to:

CLO	Statement	Learning Domain	Taxonomy Level	PLO	PEO
CLO-1	**Demonstrate** farm water management components and importance	Cognitive	C 3	PLO-1	PEO1
CLO-2	**Design and formulate** different water conveyance, storage, and conservation techniques	Cognitive	C 6	PLO 3	PEO1
CLO-3	To discuss and respond actively during field work	Affective	A2	PLO 3	PEO3

Course outline:

1. Watercourse Design and Improvement

a. Introduction
b. Planning for watercourse improvement.
c. Design criteria.
d. Hydraulics of watercourse design,
e. Different cross sections of watercourse,
f. Materials and procedures,
g. Moghas,
h. Construction of unlined and lined watercourses,
i. OFWM structures (conveyance, control)

2. Water Management through Precision Land Leveling

a. . Precision land leveling,
b. .Objective,
c. . Advantages and disadvantages of land leveling,
d. . Farm assessment and layout,
e. . Traditional survey layout procedure.

f. . Adjustment of borrow and fill,
g. . procedure for sloping fields,
h. . Land leveling maintenance

3. Water Storage Tanks

a. Sizing a water storage tanks,
b. Considerations in sizing water storage tanks,
c. General criteria, Design of storage tanks,
d. construction of water storage tank,
e. Preparatory works,
f. Materials and procedures,
g. Concrete base,
h. Brick or stonewalls,
i. Concrete walls,
j. Backfilling.
k. Stone pitching,
l. Quantities

4. Water Harvesting

a. Introduction,
b. Goals and objectives,
c. Site selection,
d. Area appraisals,
e. Topographical surveys,
f. Land use plane and work plan,
g. Land development and conservation structures,
h. Leveling, terracing,
i. Improved bunds,
j. Improved tillage,
k. Field spillways,
l. water ways,
m. diversion ditches,
n. Storage structures,
o. Water balance,
p. Site investigation,
q. Water retention dams/ponds

5. Agronomy Practices for Water Management

a. Development of Crops and Cropping Systems,
b. Principles of Crop Management,
c. Management of land and Soil

6. Conjunctive Use of Water

a. Conjunctive use of saline groundwater,
b. Effects of sediment and salinity on conjunctive use of water.

Practical:

- Design of watercourse for a given command area
- Performance evaluation of different lining materials
- Survey, planning, execution and evaluation of laser land leveling

- Measurement of water saving through laser land leveling versus conventional practice
- Design of water storage tank for a given command area
- Design of micro and mini dams

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. On Farm Water Management Field Manuals, (Revised1996-97)
    a. Vol. IV Watercourse Design and Improvement.
    b. Vol. V Land Development Precision Land Leveling and level Border Design.
    c. Vol.VI Irrigation Agronomy.
    d. Vol. VII Water Storage Tanks.
    e. Vol. X Water Harvesting and Spate Irrigation
2. Ministry of Food, Agriculture and Livestock (Federal Water Management cell) Government of Pakistan, Islamabad.
3. Hoffman, G. J, T.A. Howell and K.H. Solomon, 1992. Management of Farm Irrigation Systems. ASAE.

I&D-405 **Farm Irrigation Systems** **3(2-1)**

Contact Hours	**FARM IRRIGATION SYSTEMS**	**Credit Hours**
Theory = 30	**I&D-405 | ELECTIVE**	**3(2-1)**
Practical = 45	**(B.Sc. Agricultural Engineering)**	Theory = 2.0
Total = 75		Practical = 1.0
		Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	**Describe** and **explain** the basic concepts of farm irrigation systems and its design components	Cognitive	C2	PLO1	PEO1
CLO2	**Apply** pertinent equations to design farm irrigation systems such as surface and pressurized irrigation	Cognitive	C3	PLO2	PEO2
CLO3	**Evaluate** the effectiveness of existing or newly designed irrigation system	Cognitive	C5	PLO4	PEO2

CLO4	**Conduct** and **Execute** different experiments to determine required data for irrigation system design	Psychomotor	P4	PLO9	PEO2

Course outline:

1. History of Irrigation:

a. Scope of Irrigation in Pakistan

b. Farm Irrigation Systems

2. Systems Design Fundamentals:

a. Functions of farm irrigation systems

b. Types of farm irrigation systems

c. Conveyance methods

d. Design of farm irrigation systems

e. Data for design

f. Water source evaluation

g. Determination of daily design requirements

3. Crop Water Requirements:

a. Pan Evaporation Method

b. Blaney Criddle Method

c. Hargreaves and Samani equation

d. FAO Radiation

e. FAO Blaney–Criddle Method

f. Penman Monteith Method

g. Jansen Haise Method

h. Modified Penman Monteith Method (Cropwat Model),

i. Water Balance Approach

j. Crop Coefficients, Evapotranspiration,

4. Plant-Water-Soil Relationship:

a. Infiltration Measurement Methods

b. Green and Ampt Model

c. Horton's Equation

d. Kostiakov Method

e. Richard's Equation

f. Double Ring Infiltrometer Test

g. Total Soil Moisture Potential

h. Soil Moisture Retention Curves

i. Soil Moisture Measurement Methods

j. Soil Analysis

k. Sieve Analysis, Pressure Membrane Apparatus.

5. Surface Irrigation:

a. Different methods of surface irrigation

b.Furrow irrigation

c. Border irrigation

d.Basin irrigation

e. Design of furrow, border and basin irrigation systems

6. Design of HEIS Irrigation:

a. History and Scope in Pakistan
b. Components of Trickle irrigation system
c. Head Unit
d.Filtration system requirement for HEIS
e. Fertigation system for HEIS
f. Design of Trickle Irrigation System for different crops

7. Sprinkle Irrigation System:

a. Types of sprinkler system
b.Components of sprinkler system
c. Pressure requirement of Sprinkler irrigation
d.Design of Sprinkler Irrigation System

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

7. Allen, R.G., Pereira, L.S, Raes, D. and Smith, M. 1998. Crop evapotranspiration (Guidelines for computing crop water requirements), FAO Irrigation and Drainage Paper 56, Rome, Italy.
8. Laffan J. 2016, Irrigation: Centre Pivot and Lateral move. NSW Agriculture, Australia.
9. Laycock A. 2007. Irrigation Systems: Design, Planning and Construction. CABI.UK
10. Majumdar D.K., 2013, Irrigation Water Management: Principles and Practices. Prentice-Hall ofIndia.
11. OFWM. 1991. OFWM Field Manual 1-4, Federal Water Management Cell. Ministry ofFood, Agriculture and Livestock, Islamabad,Pakistan.
12. Tripathi N. 2014. Irrigation, Watershed and Drainage. Agrotech Press, India.

I&D-406 Groundwater Hydrology 3(2-1)

Contact Hours	**Groundwater Hydrology**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**I&D-406 | ELECTIVE** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN basic terminologies related to Hydrogeology, soil water movement and Describe laws of groundwater,	Cognitive	C2	PLO1	PEO1

	aquifer characteristics, groundwater contamination, well hydraulics and well design.				
CLO2	APPLY theoretical knowledge and laws to solve problems regarding groundwater flow measurement and aquifer properties	Cognitive	C3	PLO2	PEO1
CLO3	Perform assigned activity as individual as well as in group	Psychomotor	P3	PLO9	PEO2

Course outline:

1. Introduction

a. Groundwater Resources of Pakistan – Potential and issues
b. Hydrogeology
c. hydrological balance
d. Soil water movement

2. Laws of Groundwater Movement

a. Darcy's Law and its applications
b. Groundwater flow equations
c. Groundwater Monitoring

3. Aquifer Characteristics

a. Types of aquifers
b. Aquifer Heterogeneity
c. Effective hydraulic conductivity

4. Groundwater Contamination

a. Solute Transport Processes
b. Dispersion and diffusion

7. Well Hydraulics

a. Steady flow in confined and un-confined aquifers
b. Steady and unsteady methods

8. Water Well Design

a. Geophysical investigation
b. Pumping Test Methods (steady and variable)
c. Well design parameters
d. Well drilling and development methods
e. Design and placing of gravel pack
f. Skimming wells
g. Scavenger wells

Practical:

- Measurements of soil loss from splash erosion by rainfall simulator
- Measurements of soil loss using universal soil loss equation
- Demonstration of moisture conservation techniques
- Performance measurement of water harvesting techniques

- Field visit to areas with water and wind erosion prevailing

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Johnson, 1988. "Ground Water & Wells" Johson and Co. USA
2. Raghunath, H.M. 2007. "Ground Water" 2nd Edition, Willy Eastern Ltd. Singapur
3. Rushton, K.R. 2007, Groundwater Hydrology: Conceptual and Computational Models, Willey, USA.
4. Bouwer, H. 1996. "Ground water Hydrology" McGraw Hill Inc. New York
5. Ahmad, N. 1985. "Ground water Resources of Pakistan" Shahzad Nazir Publisher

I&D-407 Irrigation Water Management Techniques 3(2-1)

Contact Hours	**Irrigation Water Management Techniques**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**I&D-407 | ELECTIVE** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESIGN and DEVELOP structures/strategies for management, harvesting, and conservation of water in irrigated and rainfed regions.	Cognitive	C5	PLO3	PEO1
CLO2	APPLY Agricultural Engineering principles and practices for crop, land, soil and water management.	Cognitive	C3	PLO1	PEO1

Course outline:

a. Concept of water management and its developments in Pakistan,
b. components of water management.

2. Water distribution:

a. Irrigation system management,
b. warabandi-types,
c. rotation system advantages and disadvantages,

d. constraints of warabandi.

3. Soil-water plant Relationship:

a. Soil moisture and its types,
b. soil moisture characteristics,
c. field capacity,
d. wilting point,
e. total available water,
f. management allowed deficit,
g. infiltration rate,
h. hydraulic conductivity.

4. Efficiencies:

a. Definition, conveyance,
b. application and storage efficiencies,
c. irrigation efficiency,
d. irrigation system efficiency.

5. Land Leveling:

a. Importance of land leveling in water management,
b. Topographic survey,
c. system layout,
d. determining cuts and fills,
e. land leveling equipment,
f. laser land leveling and use of total station.

6. Discharge Measurement:

a. Units of measurement, equipment and methods of measurement,
b. interpretation of discharge data,
c. waterlosses.

7. Watercourse Design and Maintenance:

a. Hydraulics of open channel flow,
b. Flow profiles,
c. design of watercourse for a command,
d. watercourse structures, cleaning and maintenance of watercourses.

8. Watercourse Construction:

a. Construction requirements andprocedure,
b. materials for construction,
c. construction machinery,
d. cost of watercourse lining and improvement.

9. Lining of Watercourse:

a. Materials of lining,
b. lining techniques,
c. cost estimate of lining.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Allen, R.G., Pereira, L.S., Raes, D. and Smith, M. 1998. Crop evapotranspiration (Guidelines for computing crop water requirements), FAO 56, Rome, Italy.
2. Jensen, M.E, 1981, Design and Operation of Farm Irrigation System. ASAE, Monograph, USA
3. OFWM. 1991. OFWM Field Manual 1-4, Federal Water Management Cell. Ministry of Food, Agriculture and Livestock, Islamabad, Pakistan.

Contact Hours	Soil Dynamics I&D-408 | ELECTIVE (B.Sc. Agricultural Engineering)	Credit Hours
Theory = 30 **Practical = 45** **Total = 75**		**3(2-1)** **Theory = 2.0** **Practical =1.0** **Total =3.0**

COURSE LEARNING OUTCOMS (CLOs)

Upon successful Competition of the Course, the student will be able to:

CLO	Statement	Learning Domain	Taxonomy Level	PLO	PEO
CLO-1	**Demonstrate** soil characteristics, strength of soil and retaining walls	Cognitive	C 2	PLO-1	PEO1
CLO-2	**Apply** soil dynamics laws for stability requirement of foundation	Psychomotor	P1	PLO 3	PEO2
CLO3	Perform assigned activity as individual as well as in group	Psychomotor	P3	PLO9	PEO2

Course Outlines

1. **Shearing Strength of Soil**:
   a. Definition, influencing factors on shear strength of soil
   b. types of shear test
   c. shear strength of sand and shear strength of clay
   d. tri-axial compression-Mohr's stress circle
   e. purpose of tri-axial test
2. **Retaining Walls:**
   a. Definition, purpose, and classification
   b. some possible forces acting on earth retaining structures
   c. Lateral earth pressure
   d. Coulomb's earth pressure theory
   e. assumptions, deficiencies in Coulomb's earth pressure theory
   f. Methods of force projection, active earth pressure
   g. derivation of active earth pressure
   h. passive earth pressure
   i. derivation of passive earth pressure

j. stress distribution diagram
k. Surcharge, various kinds of surcharge

3. **Bearing Capacity of Soil:**
   a. Stability requirements of a foundation
   b. sources of obtaining values of soil bearing capacity
   c. soil loading test, soil bearing capacity
   d. calculations by means of classical earth pressure theory
   e. Determination of consolidation under given load
   f. Determination of shear strength of soil
   g. Coulomb's earth pressure theory
   h. Methods of force projection

Practical

- Determination of consolidation under given load.
- Determination of shear strength of soil.
- Coulomb's earth pressure theory.
- Methods of force projection.

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg. disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment: Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Books Recommended

1. Jumikis, A.R. 1994. Soil Mechanics, D. Van Nostrand Company Inc., Princeton, New Jersey.
2. Terzaghi, K. 1997. Soil Mechanics in Engineering Practice. John Wiley & Sons, New York.
3. Mckeyes, E. 1989. Agricultural Engineering Soil Mechanics. Elsevier New York.Smith, G.N. 1990. Elements of Soil Mechanics. BSP Professional Books, Oxford.

Contact Hours Theory = 30 Practical = 45 Total = 75	**WATER RESOURCES ASSESSMENT AND MANAGEMENT** **I&D-409 | ELECTIVE** **(B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	UNDERSTAND the basic knowledge Pakistan's existing water resource and future perspectives.	Cognitive	C2	PLO1	PEO1

CLO2	ANALYZE the problems regarding water resource management	Cognitive	C4	PLO4	PEO1
CLO3	INVESTGATE the prospects of stakeholder engagement for formulating future management scenarios	Affective	A3	PLO10	PEO2
CLO4	DEMONSTRATE the operating principal and associated issues in water resource management through dam, canals and farm visits.	Psychomotor	P1	PLO9	PEO3

Outline:

- **Introduction**

Uses, sources, foot print and history of water resources
Overview of global water resources, zonal classification, and climate change impacts
Systems approach to water resource assessment and management.
Water demand management and Integration in water management.
Stakeholders and participatory water management.

Sustainability metrics and assessment methodologies:

Methodological frameworks and measurement tools. Indicators, targets and thresholds.
water resource assessment frameworks, strategic environmental assessment

- social impact assessment
- sustainability appraisal
- environmental social impact assessment.

Adaptive management and stakeholder engagement:

Uncertainty and resilience

- Adaptive capacity and adaptive management.
- Goal based participatory process design.
- Engineers and engaging in problem definition through dialogue with relevant stakeholder groups.
- Stakeholder identification. Establishing and managing multi stakeholder groups and processes

Development and implementation of integrated water management plans

Steps in developing an integrated watershed management plan.
Water resource management case studies around the world (Case study 1)
Importance of cross-scale considerations and local conditions in management (Case study 2)

Groundwater Development in the Indus Basin

Public & Private sector development
Groundwater mining
Artificial recharge
Conversion to demand-based system and surface storages
System inefficiencies
Conjunctive use of surface and groundwater

- **Complex problems and open ended tasks**

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books/readings:

1. Mulder, K. 2006. Sustainable Development for Engineers. Greenleaf Publishing. Sheffield, UK.
2. Wimm, W. and Kauffman, J. 2011. Handbook of Sustainable Engineering. Springer. New York, USA.
3. Brooks, D. 2006. An operational definition of water demand management. Water Resources Development.
4. Hassing, J., Ipsen, N., Clansen, T., Larsen, H., Lindgaard-Jorgensen, P. 2009. Integrated water resources management in action. UNESCO Publication
5. Fischhendler, I. 2008. Institutional conditions for IWRM: The Israeli Case. Groundwater, 46, 91-102.
6. Kennedy, K., Simonovic, S., Tejada-Guibert, A., Doria, M., Martin, J. 2009. IWRM implementation in basins, sub-basins and aquifers: state of the art review. UNESCO Publication

13.3 Elective Courses for Farm Machinery and Power

Course ID	Course Title	Cr. Hrs	Theory	Prac.	Total
FMP-404	Boiler Engineering and Power Plants	3(2-1)	2	1	3
FMP-405	Post-Harvesting Technologies	3(2-1)	2	1	3
FMP-406	Energy in Agriculture	3(2–1)	2	1	3
FMP-407	Emerging Farm Engineering Systems	3(2-1)	2	1	3
FMP-408	Hydraulic Machinery and Automation	3(2-1)	2	1	3
FMP-409	Electronics Engineering	3(2-1)	2	1	3
FMP-410	Robotics in Agriculture	3(2-1)	2	1	3
FMP-411	Precision Agriculture	3(2-1)	2	1	3
FMP-412	Design of Agricultural Machinery	3(2-1)	2	1	3
FMP-413	Agro-Industrial Engineering	3(2-1)	2	1	3

FMP-404 Boiler Engineering and Power Plants
3(2-1)

Contact Hours	**Boiler Engineering & Power Plants**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**FMP- 404| ELECTIVE** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	Describe and explain the types of boiler, their construction, mountings, accessories, steam nozzles, properties of steam, steam turbine and impulse turbine and power plants	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO2	**SOLVE** problems of stream nozzles and turbine design	Cognitive	C3 Applying	PLO1 Engineering Knowledge	PEO1
CLO3	Observe the working of boiler, steam power plant jet power plants, turbine power plants model and use modern data acquisition system to analyze the functioning of plants and its components.	Psychomotor	P2 Set	PLO2 Problem Analysis	PEO2

Course Outline:

1. Introduction

a. Boiler types, construction

b. Mounting, accessories steam cycle

2. steam nozzles,

a. Supersaturated expansion in nozzles

b. Heat drop in saturated and supersaturated expansion, steam injector

3. steam turbine and impulse turbine,

a. Work done, velocity diagram, work done in blading

b. Velocity compounding, pressure compounding

c. Heat account for boiler and turbine, amount of fuel burnt

d. Acceptance tests, analysis and calorific value of fuel

e. Analysis of flue gases, amount of steam produced

4. Pressure and quality of steam,

a. Design of boiler

b. Pressure control system devices

5. Properties of steam,

a. Enthalpy of water, dryness fraction, enthalpy of wet steam,

b. Steam tables, superheated steam, internal energy of steam.

6. Steam Power Plants

a. Introduction, general layout of modern steam plants,

b. Steam generators, engines and auxiliary components,

c. Back pressure and pass out turbines,

d. Deviation of actual cycle from ideal,

e. Turbine pump and condenser.

7. Gas Turbine and Power Plants:

a. Introduction, the gas turbine cycle, modification in basic cycle,

b. Isentropic efficiency of Compressors and turbines,

c. Intercooling and reheating,

d. Explosion type gas turbine with Solar heating,

e. Development and improvement in gas turbine.

8. Jet propulsion plant

a. Introduction

b. comparison of steam and gas power plants.

Practical

1. Demonstration and inspection of different types of boilers.
2. Determination of calorific value of fuel
3. Analysis of flue gases using gas analyzer
4. Quality analysis of steam
5. Measurement of impulse force on vane of turbine
6. Assessment of power generation at output shaft
7. Visit to different power plants
8. Visit to sugar and textile industries to study boilers and steam power.
9. Visit to nuclear and steam power plants.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Chattopadhyay, P. 2000. Boiler Operation Engineering. TATA McGraw HillPub. Co. Ltd., New Dehli, India.
2. Kearton, W. J. 1999. Steam turbine theory and practice. 7th ed. CBS publishers & Distributors. New Delhi, India..
3. Granet, I. and M. Bluestein. 2001. Thermodynamics and heat power, Pearson Education Asia.
4. Cengel, Y. A. R. H. Turner. 2005. Fundamentals of thermal fluid sciences. McGraw Hill International.

FMP-405 Post-Harvesting Technologies 3(2-1)

Contact Hours	**POST-HARVESTING TECHNOLOGIES**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**FMP-405 | ELECTIVE** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

**** The CLOs and associated mapping updated by the Board of Studies of Agricultural Engineering in its meeting held on 26th May 2022**

COURSE LEARNING OUTCOMES (CLOs)**

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIBE the factors effecting the grains quality, pre- and post-harvest handling, dryers and storage	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO2	APPLY the existing drying and grain storage system for grain handling	Cognitive	*C3 Applying*	*PLO2 Problem Analysis*	PEO1
CLO3	IDENTIFY the basic requirements of storage structures, and grain storage	Psychomotor	P2 Set	PLO4 Investigation	PEO2

Course Outline:

1. Introduction

a. Importance of cereal grains and other food products
b. Food preservation, the food cycle
c. Important factors of food production

2. Properties of Cereals

a. Cereal rains and their structure,

b. Physical properties, biochemical properties

3. Factors Affecting Grain Stability

a. Physical factors, biological factors

b. Chemical factors, thermal factors

4. Post-harvest Losses

a. Forms and measurement of post-harvest losses

b. Measures to control losses

5. Pre-storage handling of Food Products

a. Physiological maturity, harvesting, threshing

b. Collection, transportation, and receiving system

6. Drying and Aeration

a. Principle of drying, solar drying, artificial drying,

b. Types of dryers, components of dryers, factors affecting drying rate,

c. Natural aeration, artificial aeration,

d. Methods of aeration, air conditioning/refrigeration

7. Storage

a. Problems in grain storage

b. Stored grain pests

c. Control methods

8. Storage Structures

a. Basic requirements for a storage structure, Classification of storage structure,

b. Considerations in selecting type of storage structure

c. Types of public storage structures, storage structure design,

d. Temporary and permanent storage facilities, Non-conventional storage facilities,

9. Grades and Standards:

a. Importance of grades and standards, food quality,

b. Establishing grades and standards,

c. Assessing the grade, grade factors and their importance,

d. Grading equipment, representative sampling,

e. WTO, ISO and its regulation regarding quality control

Practical:

- Measurement of moisture content of grain, fibre, and other food products
- Measurement of size, shape, density, specific gravity, porosity, angle of repose, coefficient of friction, hardness test.
- Thermal properties of biological materials; specific heat, thermal conductivity.
- Study of air conditioning and refrigeration plants.
- Study of storage structures and their specifications.
- Visits to public / private storage structures.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term.

Suggested Books:

1. Ahay, K. M. and K. K. Singh. 2002. Unit operation of agricultural processing. 2 ed. Vikas Publishing House, New Delhi, India.
2. Pandey, H. H. K. Sharma, R. C. Chauhan, B. C. Sarkar and M. B. Bera. 2004. Experiments in food process engineering. CBS Publishers and distributers, New Delhi, India.
3. Toledo, R.T. 1980. Fundamentals of food processing engineering. AVI Pub. Co., Inc. Westport Connecticut.
4. Mohsenin, N.N. 1980. Thermal properties of food and agricultural materials. Gordon and Breach, N.Y., USA.
5. Mclean, K.A. 1980. Drying and storing combinable crops. Farming Press, Ltd. Wharfedale Road, Ipswich, Suffolk

FMP-406 Energy in Agriculture 3(2-1)

Contact Hours	**ENERGY IN AGRICULTURE**	**Credit Hours**
Theory = 30	**FMP-406 | ELECTIVE**	**3(2-1)**
Practical = 45	**(B.Sc. Agricultural Engineering)**	Theory = 2.0
Total = 75		Practical = 1.0
		Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	Understand the methods to produce energy in agriculture, using renewable sources from engineering point of view.	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO2	Respond and understand meaning of potential energy sources in agriculture and re-state, interpret and extrapolate data from these sources.	Affective	A2 Responding	PLO2 Problem Analysis	PEO1
CLO3	Analyze energy sources in agriculture and their potential across country from environmental point of view.	Cognitive	C4 Analyzing	PLO1 Engineering Knowledge	PEO3
CLO4	Perform energy audit and energy utilization in agriculture using teamwork, interpersonal skills and professional growth.	Psychomotor	P3 Guided Response	PLO4 Investigation	PEO2

Course Outline:

1. Introduction:

a. Overview of various types of energy sources
b. Renewable and Non-renewable and their potential in the country

2. Energy audit

a. Energy utilization in agriculture
b. fertilizer (organic/inorganic), chemical controls, irrigation,
c. mechanization, post-harvest system and food consumption.
d. Technological alternative for efficient energy management in agriculture

3. **Energy from agricultural crops/wastes**

a. Energy production from biomass
b. Energy densities of biomass

4. Biogas

a. Various types of biogas plants
b. Design, installation
c. operation and management of biogas plants

5. Bio-diesel

a. Design, installation,
b. Operation and management of bio-diesel plants

6. Solar energy

a. Solar radiation, basic earth-sun angles, time derived solar angles,
b. Estimation of solar radiation, radiation measurements,
c. Solar flat plate collectors for agricultural applications,
d. Solar energy in agriculture (green houses and distillation)

7. Wind energy

a. Wind energy potential in the country.
b. Application of wind energy (domestic / agriculture).
c. Design of vertical and horizontal axis for wind mills
d. Wind operated pumps for water lifting.

8. Energy management:

a. Energy conservation in tillage,
b. Harvesting, threshing, and irrigation operations

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Sorensen, B. 2004. Renewable Energy. 2004. Elsevier Academic Press, UK
2. Singh, M. P. 2005. International Encyclopedia of energy. DAYA Publishing House, Delhi, India
3. Board, N. Handbook on biogas and its application. National Institute of Industrial Research, Delhi, India
4. Pimental, D. 1993. Hand Book of Energy Utilization in Agriculture. CRC Press Inc. Florida, USA.
5. Rai. G. D. 2001. Solar energy utilization. Khanna Publishers, N. Delhi, India

6. Stout, B.A., 1990. Hand Book of energy for world agriculture. Elsevier Applied Science Ltd.

FMP-407 Emerging Farm Engineering Systems
3(2-1)

Contact Hours	**EMERGING FARM ENGINEERING SYSTEM**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**FMP- 407| ELECTIVE** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO#	**CLO**	**Learning Domain**	**Taxonomy**	**PLO**	**PEO**
CLO1	Define basic terms/principles related to modern agricultural machines	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO2	Explanation the working principles innovative design of precision planting, sowing, plant protection machinery	Cognitive	C3 Applying	PLO1 Engineering Knowledge	PEO1
CLO3	Perform the experiments to evaluate the emerging machinery performance	Psychomotor	P2 Set	PLO9 Individual and Teamwork	PEO2
CLO4	**Demonstrate** the assigned task reliably independent of help.	Psychomotor	P3 Guided Response	PLO9 Individual and Teamwork	PEO2

Course outlines:

1. Emerging Farm Systems
2. Soil and crop mapping sensors,
3. Machine vision technologies,
4. Precision planters, pneumatic seed drill, direct seeding rice drill, real time data acquisition systems,
5. Sensor integration technologies
   a. Variable rate technology (VRT) sprayers,
   b. Satellite imagery and advanced sensors,
   c. Unmanned aerial vehicles (UAVs)/ drones
6. Decision support systems (DSS),
7. Crop stress and yield monitoring
8. Vertical farming techniques (Tunnel and Hydroponic)
9. Poultry mechanization

10. Dairy mechanization
11. Aquaculture mechanization
12. Api and Seri culture

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Stockel, W. M., M. T. Stockel and C. Johanson 2015. Auto Fundamentals. The Goodheart-Willcox Company, Inc. Tinley Pbark, IL, USA.
2. Zhang, Q. 2015. Precision Agriculture Technology for Crop Farming. CRC Press Publishers Pvt. Ltd. Taylor & Francis Group.

FMP-408 Hydraulic Machinery and Automation
3(2-1)

Contact Hours Theory = 30 Practical = 45 Total = 75	**HYDRAULIC MACHINERY AND AUTOMATION** **FMP-408 | Engg Elective (B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
1	Define hydraulic systems, hydraulic control systems and hydraulic system instrumentation	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
2	Explain hydraulic fluids flow, hydraulic components and solve related numerical problems	Cognitive	C3 Applying	PLO2 Problem Analysis	PEO1
3	Demonstrate the construction and working of hydraulic systems and its control systems	Psychomotor	P3 Guided Response	PLO9 Individual and Teamwork	PEO2

Course outlines

1. Introduction

a. Basic concepts and formation of hydraulic systems

b. Overview of hydraulic control systems

2. Fluid mechanics for hydraulic control systems

a. Fluid properties and hydraulic fluids
b. Fluid flow concepts and basic equations
c. Inner flow in hydraulic systems
d. Oil hammer
e. Cavitation

3. Hydraulic components

a. Hydraulic pumps and motors
b. Hydraulic actuators, hydraulic jacks
c. External and internal hydraulic cylinders
d. Hydraulic control valves, pressure control valves, directional control valves, and flow control valves
e. Hydraulic system components

4. Hydraulic control systems

a. Configuration of the components in hydraulic servo system
b. Basic theory of control engineering
c. Dynamic characteristics of a hydraulic component
d. Design of a hydraulic control system

5. Hydraulic system instrumentation

a. Metering, measuring, and monitoring devices.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Noah, D. M., R. C. Fales. 2019. Hydraulic control systems. 2nd Ed. John Wiley & Sons, Inc., USA.
2. Konami, S. 2016. Hydraulic control systems: Theory and practice. WSPC Publisher. US

FMP-409 Electronics Engineering 3(2-1)

Contact Hours	**ELECTRONICS ENGINEERING**	**Credit Hours**
Theory = 30	**FMP-409 | ELECTIVE**	**3(2-1)**
Practical = 45	**(B.Sc. Agricultural Engineering)**	Theory = 2.0
Total = 75		Practical = 1.0
		Total = 2.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO

CLO1	DEFINE the types of current, and other electric parameters along with related laws	Cognitive	C1 Remembering	PLO1 Engineering Knowledge	PEO1
CLO2	DESCRIBE the semiconductors, rectifiers, amplifiers, controllers, signals, timers and and counters (etc.)	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO2	DEMONSTARTE the electronic gates and circuits	Psychomotor	P1 Perception	PLO1 Engineering Knowledge	PEO1

Course outlines

1. **Introduction to electronics**
   a. Conductors
   b. Alternating current and direct current
2. **Resistance, capacitance and RC time constant**
3. **Inductance**
4. **Semiconductors**
   a. Diodes, Zener diode and DIAC
   b. Transistors and their configurations
   c. Field effect transistors
5. **Rectifiers and power regulators**
6. **Amplifiers**
7. **Signals**
   a. Analog signals
   b. Digital signals
8. **Gates, flip flop, registers (SISO, SIPO, PIPO, PISO)**
9. **Timers and counters**
10. **Microcontrollers**
    a. Capabilities and structure
    b. Basics of microcontroller programming
11. **Circuit designing and simulation**

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Valchev, V. C. and A. Van den Bossche, 2018. Inductors and transformers for power electronics. CRC press, USA.
2. Skvarenina, T. L. 2018. The power electronics handbook. CRC press, USA.
3. Ioinovici, A. 2013. Power Electronics and Energy Conversion Systems: Fundamentals and Hard-switching Converters, Volume 1: John Wiley and Sons, NY, USA.

FMP-410 **Robotics in Agriculture**

3(2-1)

Contact Hours	**ROBOTICS IN AGRICULTURE**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**FMP- 410| ELECTIVE** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	Define basic terms/principles related to controllers, converters and protocol to electronic devices and sensors and actuators	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO2	Application of sensors and actuators for efficient operation and robotics operation in farm field	Cognitive	C3 Applying	PLO1 Engineering Knowledge	PEO1
CLO3	Perform the experiments related to sensor performance in relation with algorithms	Psychomotor	P3 Guided Response	PLO5 Modern Tool Usage	PEO2

Course outlines:

Introduction

Controller types and characteristics

Analog to digital converters

Digital to analog converters

Communication protocols among electronic devices

Sensors and their integration with micro/controllers

a. Temperature sensor
b. Humidity sensor
c. Moisture sensor
d. pH and ORP sensors
e. Color sensor
f. Light sensor
g. Hall effect sensors (speed and flow sensors)
h. PID sensor
i. Pressure sensor
j. Miscellaneous sensors

Actuators

a. Electromagnetic actuators (gear, servo and stepper motors based actuators)
b. Hydraulic actuators (flow control valve, pressure regulator, pressure relief valve, hydraulic motor, hydraulic cylinder)

c. Pneumatic actuators (air pump, compressor, control valve, pneumatic cylinder)

Controller designing and simulation

Equipment telematics, agricultural robotics, robotic farm swarms,

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Gieras, J. F., J. Piech, and B. Tomczuk, 2018. Linear synchronous motors: transportation and automation systems: CRC press, USA
2. Blevins, T., W. K. Wojsznis and M. Nixon. 2013. Advanced control foundation: tools, techniques and applications: International Society of Automation (ISA).
3. McMillan, G. K., C. M. Toarmina, 2011. Advanced Temperature Measurement and Control: International Society of Automation, USA.

FMP-411 Precision Agriculture 3(2-1)

Contact Hours	**PRECISION AGRICULTURE**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**FMP- 411| Elective** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	Explain the basic concepts of irrigation systems, farming systems, precision farming, global positioning system, remote sensing, satellite and aerial imagery and VRT plant protection equipment	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO2	Analyze crop health using crop, soil and nutrient mapping obtained from remote sensing technologies.	Cognitive	C3 Applying	PLO1 Engineering Knowledge	PEO1
CLO3	Evaluate the effects of variable rate technology on crop health using crop, soil and nutrient mapping obtained from remote sensing technologies for development of decision support systems.	Psychomotor	P3 Guided Response	PLO5 Modern Tool Usage	PEO2

Course outlines:

- **Explain precision agriculture**

- Explain global positioning system
- Explain geographical information system
- Discuss soil fertility sensors
- Discuss yield monitors
- Explain Variable Rate Technology (VRT)

VRT fertilizer applicators, plant protection VRT applicators

- Describe remote sensing
- Discuss application of remote sensing in precision agriculture
- Generate crop management zones and soil maps
- Discuss monitoring of crop health
- Discuss management decision support systems
- Discuss future prospects and developments

Practical:

During this course students will learn and use following computer software:

- ArcGIS 10.4, ERDAS IMAGINE, DSSAT 4.6, GS+

Practical, trainings and field work include:

- Use of GPS Receiver, Differential Global Positioning System (DGPS), Process of Spatial Variability Analysis, Crop monitoring by UAV, Application of Variable Rate Technology

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term.

Suggested Books:

Precision Agriculture' 19 by John V. Stafford, ISBN:9789086863372

FMP-412 **Design of Agricultural Machinery**

3(2-1)

Contact Hours Theory = 30 Practical = 45 Total = 75	**DESIGN OF AGRICULTURAL MACHINERY** **FMP- 412| ELECTIVE** **(B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	Define the theoretical concepts for designing and development of different parts of agricultural machinery	Cognitive	C1 Remembering	PLO1 Engineering Knowledge	PEO1
CLO2	Discuss the construction and working of different machine elements.	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO3	Apply the standard procedures and techniques to design different machine elements.	Cognitive	C3 Applying	PLO1 Engineering Knowledge	PEO1
CLO3	Develop different theoretical and practical machine elements actually used in agricultural machinery	Psychomotor	P2 SET	PLO9 Individual and Teamwork	PEO2
CLO4	Manage the performance of developed parts of agricultural machinery	Psychomotor	P3 Guided Response	PLO9 Individual And Teamwork	PEO2

Course outline:

- **Philosophy of design**
  - Formulating of procedure, importance of machine design in agricultural machinery, reliability
  - Engineering standards, user economics.
- **Tolerance design and statistics**
  - Tolerance and allowances
  - Application of statistics to manufacturing.
- Stresses:
  - Stress failure theory, design for deflection, strain determinations, stresses caused by impact.
  - Power transmissions: V-belt forces, kinematics and design procedure, chain drive, forces, selection and design procedure. Universal joints,
  - Description and functioning in agricultural machinery.
- Linkages in farm machinery

- ○ Velocity and acceleration determination,
- ○ Four bar mechanism,
- ○ Machinery mechanism,
- ○ Forces on plows and discs.

● Hydraulic power system
- ○ Hydrostatic drives and hydraulic pumps
- ○ Pump performance and rating,
- ○ Hydraulic motors performance and rating,
- ○ Control valves, hoses and fitting, cylinders.

● Design of surfaces of plow bottoms
- ○ Design of moldboard plow and disk plow.
- ○ Stability of plows: Force equilibrium and stability,
- ○ Supporting elements,
- ○ Plow stability in horizontal plane,
- ○ Procedure for measuring the quality and testing plows.

Teaching Methodology:

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:

Mid Term, Report writing/Presentation, Assignments, Quizzes, Design Projects, Complex Problems, Final Term

Suggested Books:

1. Budynas, R.G. and J.K. Nisbett. 2015. Mechanical Engineering Design. 10thEdition. Published by McGraw Hill Education, NY, USA.
2. Chen, G. 2018. Advances in Agricultural Machinery and Technologies. 1st Ed. Published by CRC Press, Taylor and Francis Group, USA.
3. Sharma, D. N. 2013. Farm Machinery Design: Principles and Problems. Jain Brothers, New Dehli, India.

FMP-413 Agro-Industrial Engineering 3(2-1)

Contact Hours	**AGRO-INDUSTRIAL ENGINEERING**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**FMP-413 | ELECTIVE** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	Apply knowledge of engineering, mathematics, science, and information technology to solve problems in agro-industry.	Cognitive	C3 Applying	PLO1 Engineering Knowledge	PEO1

CLO2	Design an agro-industrial system that integrates aspects of process technology, industrial systems engineering, and environmental technology to meet intended purpose within realistic constraints	Cognitive	C6 Creating	PLO3 Design / Development of Solutions	PEO3
CLO3	Apply and transform ideas into agro-industry business (technopreneurship) using teamwork, interpersonal skills and professional growth.	Cognitive	C3 Applying	PLO4 Investigation	PEO2
CLO4	Perform, design and conduct lab and field experiments as well as to analyze processes integrated in agro-industry and interpret data.	Psychomotor	P3 Guided Response	PLO5 Modern Tool Usage	PEO1

Course outline:

1. Introduction:

a. Industrialization and industrial policies of Pakistan; classification of agro-based industries, management,

b. Operations research, system engineering, statistics,

c. Ergonomics, manufacturing engineering,

d. ISO and WTO regulations.

2. Production system design:

a. Mill and plant layout

b. Line diagrams;

c. Flow diagrams,

d. Work measurement,

e. General terminologies used in physical measurements.

3. Product system control:

a. Inventory control, production control, production planning, quality control, statistical process

b. Control charts, sampling plan, total quality management.

4. Industrial management:

a. Definition of management, functions of management, personal management, human resource development,

b. Policy formulation and decision making.

c. Materials purchase and stores management.

d. Cost management,

e. Production routing,

f. Scheduling and dispatch management.

5. Operations research:

a. Introduction, linear programming, graphical and algebraic method,

b. Transportation algorithm, assignment algorithm,

c. Queuing theory and simulation.

6. Engineering economy:

a. Pricing, costing, interest calculation, present worth, future worth, annual rate of return, annual cost method, return on investment, payback method,

b. Cost control engineering.

7. Industrial safety engineering

a. Safety measures, accidents cause, job safety analysis.

b. Machine guards and safety equipment

c. Control of noise, contaminants and radiation/heat etc.

d. Health hazards and safety management.

e. Health and safety policies.

8. Industrial environmental communication and pollution:

a. Industrial environmental education,

b. Factors affecting environment of different industries,

c. Environmental planning,

d. Monitoring and control strategies of recycling materials for ecological balance.

e. Sources of pollution, e.g. natural sources, industrial sources, point sources and non-point sources.

f. Industrial revolution and its impact on soil, water, air and human health.

g. Effect of unplanned technological growth on environmental pollution.

Teaching Methodology:

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:

Mid Term, Report writing/Presentation, Assignments, Quizzes, Design Projects, Complex Problems, Final Term.

Suggested Books:

1. Hicks. P. 1994. Industrial engineering and management. 2nd Ed, McGraw Hill International Edition, New York.
2. Kumar, B. 2001. Industrial Engineering. Khanna Publishers, Nath Market, Delhi, India.
3. Patil, S.B. 2008.Industrial Engineering and Management. Technical Publications, Pune, India.
4. Reddy, C.N.M. 2007. Industrial Engineering and Management. New Age International Publishers, India.
5. Telsang, M. 2004. Industrial Engineering and Production Management. Tata McGraw Hill. N. Delhi, India.

13.4 Elective Courses for Structures and Environmental Engineering

Course ID	Course Title	Cr. Hrs	Theory	Prac.	Total
SEE-403	Quantity Survey and Cost Estimation	3(2-1)	2	1	3
SEE-404	Landscape Engineering	3(2-1)	2	1	3
SEE-405	Environmental Modeling and Simulation	3(2–1)	2	1	3
SEE-406	Sustainable Environment	3(2-1)	2	1	3
SEE-407	Cleaner Production Techniques	3(2-1)	2	1	3
SEE-408	EIA and EMS for Industries	3(2-1)	2	1	3
SEE-409	Environmental Impact Assessment	3(2-1)	2	1	3

SEE-403 Quantity Survey and Cost Estimation
3(2-1)

Contact Hours	**QUANTITY SURVEY AND COST ESTIMATION**	**Credit Hours**
Theory = 30	**SEE-403 | ELECTIVE**	**3(2-1)**
Practical = 45	**(B.Sc. Agricultural Engineering)**	Theory = 2.0
Total = 75		Practical = 1.0
		Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN the terminologies/processes related to quantity surveying, estimation and tendering and to prepare manual Bill of Quantities (BOQ)	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO2	APPLY different estimation methods to prepare bill of quantities and cost estimates of engineering projects/activities.	Cognitive	C3 Applying	PLO3 Design/Development of Solutions	PEO2
CLO3	COMPUTE quantity and cost of project in field	Psychomotor	P4 Mechanism	PLO11 Project Management	PEO3

Course Outline:

Bill of Quantities (B.O.Q) & Measurement Book (M.B):

1. Types and methods of estimates,
2. Working out quantities, rates and cost analysis of construction materials; Valuation, depreciation and sinking fund.

3. Contents and preparation of bills of quantities for different projects like irrigation, roads, sanitary, building etc. and maintaining of Measurement Books.
4. Measurement, specification and costing of excavation and back filling, mass concrete retaining walls, beams, concrete piles, steel or wooden truss or steel framed gantry, estate road, sewer and water main pipe works, Priced bill of quantity.
5. **Tendering:** Preparation of engineering contracts and tender documents. Introduction to claims and conflicts resolution e.g. escalation, indexation, arbitration and litigation. Evaluation of proposals and contracts.

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. E.W. Steel and Terence J. Mc GHEE, Estimating & Costing.
2. S. Dutta, Estimating and Costing in Civil Engineering, 22nd PP ed. S. Dutta & Co. Lakhnow.
3. D.D.Kohli, Estimating, Costing and Accounts, 9th PP ed. S.Chand & Co. Pvt. Ltd.

SEE-404 **Landscape Engineering** **3(2-1)**

Contact Hours	**LANDSCAPE ENGINEERING**	**Credit Hours**
Theory = 30	**SEE-404 | ELECTIVE**	**3(2-1)**
Practical = 45	**(B.Sc. Agricultural Engineering)**	Theory = 2.0
Total = 75		Practical = 1.0
		Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)
Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	DESCRIPTION of the elements and principles of Landscape Designs	Cognitive	C2 Understanding	PLO1 Engineering Knowledge	PEO1
CLO2	DEMONSTRATION of wide range landscape Engineering skills, techniques and their application to landscape design using software	Cognitive	C3 Applying	PLO5 Modern Tool Usage	PEO2
CLO3	APPLY theory and precedents of landscape engineering to individual land reclamation project in	Psychomotor	P4 Mechanism	PLO3 Design/ Development of Solutions	PEO3

	field				
CLO4	COMPUTE the cost of a landscape design	Affective	A3 Valuing	PLO11 Project Management	PEO3

Course Outline:

1. Introduction, importance of landscaping, gardening and its design,
2. principles and elements of landscape design, landscape design materials,
3. types of designs; formal and informal garden designs, Chinese and Japanese gardening, rockeries, terrace, roof and water gardens,
4. plants suitable for various designs,
5. landscape designs for public and private buildings, parks and playgrounds etc.,
6. highway and roadside plantations,
7. developmental cost estimates for landscape.

Practical:

Visits to different parks and gardens, landscape designs for private and community houses, schools, colleges, universities, municipal and national parks, industrial areas and roadsides; establishing various types of gardens. Field surveys for earthwork estimates as per maps. Designs of irrigation systems, exercises in search for state of the art information

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Arora, J.S. 1992. Introductory Ornamental Horticulture. Kalyani Publishers, New Delhi.
2. Booth, N.K. and W.H. Elsevier. 1983. Basic elements in Landscape Architecture Design. Science Publishing Co., New York.
3. Khan, M.A. and T.A. Bader. 1992. Landscape Designs, Student Manual. University Printing Press, University of Agriculture, Faisalabad.
4. McDaniel, G.L. 1982. Ornamental Horticulture. The Reston Publishing Company; Prentice Hall Co., Reston, Virginia.
5. Raj, D. 2002. Floriculture and Landscaping. Kalyani Publisher, New Delhi

SEE-405 Environmental Modelling and Simulation 3(2-1)

Contact Hours	**ENVIRONMENTAL MODELLING AND SIMULATION**	**Credit Hours 3(2-1)**
Theory = 30 Practical = 45 Total = 75	**SEE-405 | ELECTIVE** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	UNDERSTANDING the main principles and approaches to modeling of environmental systems	Cognitive	C2 Understanding	PLO2 Problem Analysis	PEO1
CLO2	APPLYING the process-driven and data driven models in environmental systems	Cognitive	C3 Applying	PLO4 Investigation	PEO1
CLO3	ANALYZE models and multi-criteria decision analysis approaches to solve engineering problems	Cognitive	C4 Analysing	PLO4 Investigation	PEO2
CLO4	Use computers, software's and information technology effectively.	Psychomotor	P4 Guided Response	PLO5 Modern Tool Usage	PEO3

Area Scope:

- To arise interest in the field of modeling and quantitative assessment of environmental problems
- To acquainted environmental regulation and policies at local, national and international levels
- To develop capability for understanding both the power and limitations of environmental models and quantitative assessment techniques

Course Outline

- **Highlight importance of Environment Modeling and Simulation (2 hour)**
  - Why model the environment?
  - Why simplicity and complexity?
  - Physical and Mathematical Models
  - Models as a Research Tool
- **Explain Concepts of Modelling (3 hour)**
  - Modelling Elements, The Modelling Procedure, Verification, Sensitivity Analysis
  - Calibration, Validation and Assessment of the Model Uncertainty
  - Model Classes
  - Selection of Model Complexity and Structure, Parameter Estimation
  - Ecological Modelling and Quantum Theory
  - Modelling Constraints
- **Details Time Series: Analysis and Modelling (3 hour)**
  - Examples of environmental time series
  - Frequency-size distribution of values in a time series
  - White noises and Brownian motion

- Other time-series model

- **Explicate Non-Linear Dynamics and Self-Organization Models (3 hour)**
  - Self-organization in complex systems
  - Cellular automaton model
  - Case study: modelling rill initiation and growth
- **Elaborate Spatial Modelling and Scaling Issues (3 hour)**
  - Scale and scaling
  - Causes of scaling problem
  - Scaling issues of input parameters and possible solutions
  - Methodology for scaling physically based models
  - Scaling land-surface parameters for a soil-erosion model: a case study
- **Elaborate Environmental Applications of Computational Fluid Dynamics (2 hour)**
  - CFD fundamentals
  - Applications of CFD in environmental modelling
- **Differentiate Stochastic versus Deterministic Approaches (2 hour)**
- **Explain Climate and Climate-System Modelling (3 hour)**
  - The complexity
  - Finding the simplicity
  - The research frontier
- **Elaborate Modelling Plant Ecology (3 hour)**
  - The complexity
  - Finding the simplicity
  - The research frontier
  - Case study
- **Explain Spatial Population Models for Animals (2 hour)**
  - The complexity
  - Finding the simplicity: thoughts on modelling spatial ecological systems
  - The research frontier: marrying theory and practice
  - Case study: dispersal dynamics in stream ecosystems
- **Elaborate Vegetation and Disturbance (2 hour)**
  - The system complexity: effects of disturbance on vegetation dynamics
  - The model simplification: simulation of plant growth under grazing and after fire
  - New developments in ecological modelling
  - Interactions of fire and grazing on plant competition: field experiment and modelling applications

- **Details Human Decision-Making in Environmental Modelling (3 hour)**
  - Scenario approaches
  - Economic modelling
  - Agent-based modelling

Labs/ Practicals:

- The course practicals/ labs should be defined and synchronized with the course outline.

Assessment:

Mid-exam, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam/ assessment.

Suggested Books

1. Ford, A., & Ford, F. A. (1999). Modeling the environment: an introduction to system dynamics models of environmental systems. Island press.
2. Peng, G., Leslie, L. M., & Shao, Y. (Eds.). (2013). Environmental modelling and prediction. Springer Science & Business Media.
3. Jørgensen, S. E., & Bendoricchio, G. (2001). Fundamentals of ecological modelling (Vol. 21). Elsevier.

SEE-406 Sustainable Environment 3(2-1)

Contact Hours Theory = 30 Practical = 45 Total = 75	**SUSTAINABLE ENVIRONMENT** **SEE-406 | ELECTIVE** **(B.Sc. Agricultural Engineering)**	**Credit Hours 3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	EXPLAIN the social, environmental, and economic dimensions of sustainability	Cognitive	C2 Understanding	PLO2 Problem Analysis	PEO1
CLO2	ANALYZE environmental problems in a structured way and develop strategies for solutions that indicate how scientific principles interact with ethical, political and/or economic principles.	Cognitive	C4 Analysing	PLO7 Environment and Sustainability	PEO2
CLO3	APPLY theoretical frameworks to real world sustainable environmental issues and practice community engagement	Psychomotor	P4 Guided Response	PLO4 Communication	PEO3

Area of scope:

The knowledge units in this area collectively encompass the following:

- Management of environmental risk
- Sustainability, environmental degradation and economic growth
- Stabilizing and reducing carbon emissions is key to living within environmental limits.
- To improve the environmental health and quality of life for our campus and community.
- Enhance live ability and create opportunities for economic prosperity

Course Outline:

- **Explain emergence of green technologies towards sustainable growth (1 hour)**
- **Explain sustainable development an earnest hope (3 hour)**
    - Evolving Concept of Sustainable Development
    - Glitches of Sustainable Development
    - Necessity of Sustainable Development
- **Detail of challenges and prospects in exploring marine microbial diversity (2 hour)**
    - Marine Environment and Its Complexity
    - Biodiversity of Marine Environment
    - Challenges in the Study of Microbial Diversity
- **Detail of bioprospecting of plant essential oils for medicinal uses (3 hour)**
    - Antibacterial Activities
    - Antifungal Potential
- **Explain Air Pollution Scenario (2 hour)**
- **Explain nanotechnology: perspective for environmental sustainability (3 hour)**
    - Potential of Nanotechnology
    - Nanotechnology: Multidisciplinary Aspects
    - Nanotechnology and Energy
- **Overview of environmental remediation using photocatalyst (3 hour)**
    - Common Materials Used as Photocatalysts
    - Photocatalytic Degradation of Organic Compounds Under UV and Visible Radiation
- **Detail role of biopolymers in industries (2 hour)**
- **Explain green federalism: towards sustainable human development (3 hour)**
    - Political Dimension of Climate Policy
    - Proactive Redress to Climate Change
- **Explain economic sustainability: Gandhian perspectives (2 hour)**
- **Explain global warming and agriculture: institutional arrangement for sustainable development (2 hour)**
- **Detail of green buildings: opportunities and challenges (3 hour)**
    - Growth and Issues of the Infrastructure Industry
    - Steps Toward a Sustainable Path and Global Environmental Advantage
    - Economic Advantages
- **Explain mathematical models in sustainable development (3 hour)**
    - Population Growth Models: Exponential Model
    - Economic Growth Model: Exponential Model Optimized

Labs/ Practicals:

- The course practical/ labs should be defined and synchronized with the course outline.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/ Quizzes, Tutorials, Case Studies relevant to Engg. Disciplines, Semester project, Guest speaker, Industrial/ Field visits, Group discussion, Report Writing.

Assessment:

Mid-exam, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam/ assessment.

Suggested Books

1. Fulekar, M. H., Pathak, B., & Kale, R. K. (Eds.). (2014). Environment and sustainable development. Springer India.
2. Blowers, A. (Ed.). (2013). Planning for a sustainable environment. Routledge.
3. Omer, A. M. (2008). Energy, environment and sustainable development. Renewable and sustainable energy reviews, 12(9), 2265-2300.

**** The course contents, ClOs and associated mapping is updated by Board of Studies of Agricultural Engineering in its meeting held on 26th May 2022**

SEE-407 Cleaner Production Techniques** 3(2-1)

Contact Hours	CLEANER PRODUCTION TECHNIQUES	Credit Hours 3(2-1)
Theory = 30 Practical = 45 Total = 75	**SEE-407 | ELECVTIVE** **(B.Sc. Agricultural Engineering)**	Theory = 2.0 Practical = 1.0 Total = 3.0

Course Learning Outcomes (CLOs) and CLO Mapping

Upon successful completion of the course, the student will be able to:

CLO	Statement	Learning Domain	PLO	PEO
CLO1	**Understand** the concept of Cleaner Production (CP) and the consequences and suggest options for preventing pollution within urban and industrial water management settings;	**Cog-2** Understanding	**PLO1** Engineering Knowledge	PEO1
CLO2	**Assess** the environmental impact of products and processes and indicate how the sustainable use of resources can be beneficial for reducing environmental burden(s)	**Cog-4** Analyzing	**PLO7** Environment and sustainability	PEO 3
CLO3	**Suggest** treatment/disposal methods for industrial wastewater from which the value has been taken out	**Cog-5** Evaluating	**PLO4** Investigation	PEO 2
CLO4	Perform basic calculations related to life cycle analysis instructed reliably and effectively	**Psy-3** Guided Response	**PLO9** Individual & teamwork	PEO 2

Course Outline

Introduction to Cleaner Production

a) Role of Industrial processes and products
b) Role and Responsibilities of Process Engineer
c) Formulation of an Industrial Cleaner
d) Formulation of a Paint Solvent
e) Overview of major environmental issues
f) General overview of Risk assessment concepts

Unit Operations and Pollution Prevention:

a) Recognition, Evaluation and Control Industrial Products exposure in the ambient environment
b) Pollution Prevention in Material selection, Storage tanks and Fugitive sources
c) Pollution Prevention for chemical reactors and separation devices
d) Integrated risk assessment with Process Design

Life Cycle Concepts and Green Engineering

a) Life-cycle Assessment, Impact Assessment and their uses
b) Comprehensive Life-cycle Management Strategy needed to ensure sustainable future
c) Environmental performance of industrial processes
d) Eco-industrial Parks
e) Zero Waste for Sustainable Development
f) Cleaner suitable Environmental Technologies
g) Psychometric Evaporation: A novel zero discharge system

Environmental Care in Manufacture of Chemicals:

a) Material selection & Process conditions
b) Zero-discharge Technologies
c) Plant Capacity& Process Patterns
d) Pollution control and environmental protection in chemical industry
    a. Dust removal
    b. Phenol removal
    c. Solvent vapor removal
    d. BOD reduction
    e. Removal of chlorine and hydrogen sulphide
    f. Chemical Treatment/Filtration
e) Optimizing energy use in process industry
f) Integrating Environment, Energy, Technology and Business Processes

Physical, Thermal and Chemical Methods of Waste Management:

a) Physical Methods
    a. Phase separation
    b. Phase transfer and transition
    c. Phase conversion
    d. Membrane separation
b) Thermal Methods (Incineration, Thermal desorption and Pyrolysis
c) Solidification and stabilization
d) Chemical Methods
e) Bioremediation

Pollution Control in Chemical Industries

a) Petroleum, Refinery and Petrochemicals, Leather and Tannery, Pulp and Paper, Pesticide, Fertilizer, Paints and dyes, Sugar, Distillery and Fermentation Products, Textile, Post-harvest industries, Food processing, Miscellaneous Process Industry
b) Biotechnology for pollution prevention in Chemical Industry
c) Instrumental Techniques for environmental pollution monitoring
d) Environmental Management in the Chemical Process Industry

Practicals:

1. Case studies of Life cycle assessment of Projects
2. Preparation of Life cycle assessment Report
3. Case studies of Air Pollution Control and wastewater reclamation

4. Methodologies for cost control
5. Analysis of oxidants
6. Analysis of Particulate Matter
7. Visit to various industries
8. Expert Lecture on Cleaner Production Techniques

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/ Quizzes, Tutorials, Case Studies relevant to Engg. Disciplines, Semester project, Guest speaker, Industrial/ Field visits, Group discussion, Report Writing.

Assessment:

Mid-exam, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam/ assessment.

Recommended Books

1. Da Silva, F.J.G., and Gouveia, R.M., 2020. "Cleaner Production". Springer International Publishing.
2. Hanley, N. and Bhatia, S.C., 2011. "Pollution control in chemical and allied industries". Alkem Company.
3. Rickson, R.E., 2015. "Evaluating environmental and social impact assessment in developing countries".
4. Cheremisinoff, N.P., 2010. "Handbook of Pollution Prevention and Cleaner Production": Best Practices in the Agrochemical Industry (Vol. 3). William Andrew.

SEE-408 EIA and EMS for Industries 3(2-1)

Contact Hours Theory = 30 Practical = 45 Total = 75	**EIA AND EMS FOR INDUSTRIES** **SEE-408 | ELECTIVE** **(B.Sc. Agricultural Engineering)**	**Credit Hours** **3(2-1)** Theory = 2.0 Practical = 1.0 Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	UNDERSTANDING the components, processes and benefits of EIA and EMS and link of EIA to EMS	Cognitive	C2 Understanding	PLO2 Problem Analysis	PEO1
CLO2	ANALYZE methods and possibilities within Environmental Management Systems for resources recovery	Cognitive	C4 Analysing	PLO4 Investigation	PEO2
CLO3	PERFORM environmental auditing of various industries for effective EMS implementation	Psychomotor	P4 Guided Response	PLO4 Investigation	PEO2

Area Scope of EIA:

The knowledge units in this area collectively encompass the following:

- EIA process initially laid emphasis on evaluating the inverse / beneficial effects of development project on physical factors air-quality, water quality and solid waste disposal.
- Then it started including biological / ecological factors which are difficult to quantify.
- Presently, EIA and EMS includes socio-economic factors like creation of employment opportunities, recreational factors and cultural impacts etc.

Course Outline:

Describe Introduction to the Environmental Impact Assessment Process

- Introduction to the EIA Process, The Legislative Background
- Criteria for Deciding whether EIA is Required
- Procedure and Provisions Introduced for Projects that Required a New Consenting
- The Contents of an Environmental Statement

Explain Prior to the Submission of the Environmental Statement

- Deciding whether EIA is Required: the 'Screening' Process
- Requiring the Submission of an Environmental Statement
- Preliminary Contact and Liaison, Scoping the Environmental Statement
- Provision of Information, Describing Baseline Environmental Information
- Predicting Environmental Impacts and Assessing the Significance of Impacts
- Mitigating Measures and Enhancement

Explain Consideration of the Environmental Statement

- Submission of Environmental Statement and Project Application
- Negotiating Modifications of the Project
- Reviewing the Environmental Statement and Formulating a Consultation Response

The Decision Making stage Adopting the Precautionary Principle

- Procedures and Relationship of EIA with the Development Plan and Other Consent
- Guaranteeing Commitments and Compliance
- The Decision of the Competent Authority

Implementation and Compliance

- Implementation of Mitigation and Compensation Measures
- Monitoring Programmes, Review and Reassessment and Remedial Programmes

Explain Environmental Management Systems

- An Environmental Management Systems Effective?
- Empirical Studies of EMSs

The Benefits and Common Characteristics of Successful Environmental Management Systems

- The Benefits of Environmental Management Systems
- Enhanced Efficiency and Lower Costs
- Reductions in Resource Use, Waste and Emissions
- The Benefits and Common Characteristics of Successful Environmental Management
- Employee Involvement

Drivers and Barriers to EMS Adoption by Small and Medium-Size Enterprises

- Technical Assistance and Outreach

Labs/ Practicals:

The course practicals/ labs should be defined and synchronized with the course outline.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/ Quizzes, Tutorials, Case Studies relevant to Engg. Disciplines, Semester project, Guest speaker, Industrial/ Field visits, Group discussion, Report Writing.

Assessment:

Mid-exam, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam/ assessment.

Suggested Books

1. Heritage, S. N. (2013). A handbook on environmental impact assessment. Guidance for Competent Authorities, Consultees and others involved in the Environmental Impact Assessment Process in Scotland, Scotland.
2. Introduction to Environmental Impact Assessment 4th edition John Glasson, Riki Therivel and Andrew Chadwick
3. Environmental Management Systems, Written by Philip J. Stapleton, Principal, Glover-Stapleton Associates, Inc. Anita M. Cooney, Project Manager NSF International, William M. Hix Jr., Intern and NSF International.

SEE-409 Environmental Impact Assessment 3(2-1)

Contact Hours	**ENVIRONMENTAL IMPACT ASSESSMENT**	**Credit Hours**
Theory = 30	**SEE-409 | ELECTIVE**	**3(2-1)**
Practical = 45	**(B.Sc. Agricultural Engineering)**	Theory = 2.0
Total = 75		Practical = 1.0
		Total = 3.0

COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of the course, the student will be able to:

CLO	CLO Statement	Learning Domain	Taxonomy level	PLO	PEO
CLO1	Explain the major principles of EIA, its role in decision making and legislative framework	Cognitive	C2 Understanding	PLO2 Problem Analysis	PEO1
CLO2	Apply the EIA process and stages to specific topic areas and prepare EIA reports	Cognitive	C3 Applying	PLO4 Investigation	PEO2
CLO3	Be able to ACCESS different case studies/examples of EIA in practice	Psychomotor	P4 Guided Response	PLO4 Investigation	PEO2

Area Scope:

- Identify and predict the impact of a project on the bio-geophysical environment and on man's
- health and well-being,
- Interpret and communicate information about the impact

- Analyze site and process alternatives and provide solutions to sift out
- Abate/mitigate the negative consequences on man and the environment

Course Contents

Introduction

- Environment
- Environmental Impact Analysis
- Significant Environmental Impacts
- Stages of Environmental Impact Analysis
- Environmental Impact and Stages of Development
- Law, Policy and Institutional arrangement for EIA system

Measure of Environmental Impacts

- Physical Environmental Variables
- Social Variables
- Economic Variables
- Other Variables
- Environmental Indices
- Impact Assessment Methods
- Air Quality Impact Assessment (3 hour)
- Basic concepts of Air Pollution
- Sources of Air Pollutants
- Role of Atmosphere as a source of Air Pollution
- Ambient Air Quality Standards
- Planning of Air Impact Assessment Exercise
- Assessment of Impacts
- Industrial studies of Air Pollution Impact Assessment

Water Quality Impact Analysis (2 hour)

- Definition and Concepts
- Water Quality Indicators and Standards
- Water Impact Factors
- Water Quality Impact Analysis
- Microbial Transformations

Soil Impact Assessment

- Basic concepts and definitions
- Land use classification of soils
- Causes of Land Degradation
- Impact Assessment
- Mitigation measures
- Other Impact Assessment (2 hour)
- Noise Impact Analysis
- Biotic Impact Assessment
- Assessment of socio-economic Impacts
- Assessment of Aesthetic Environmental Impact
- Strategic Environmental Assessment

Methods of EIA

- Adhoc method.
- Checklist method.

- Matrix method.
- Network method.
- Overlay method.
- Environmental index using factor analysis.
- Cost/Benefit analysis.
- Predictive or Simulation methods
- Environmental Impact Assessment Report (2 hour)
- Initial impact report
- EIA environment and health
- Management, monitoring and auditing
- EIA techniques
- Final EIA and EMS Report
- Environmental Impact Assessment (2 hour)
- Economic Approaches to EIA
- Indoor climate of Pollution
- Industrial sector Analysis of Environmental Impacts
- EIA Project Management

Environmental Management System

- Basic definitions and terms
- Framework for environment management system
- Approach for developing an Environmental Management System

Introduction and Implementation of ISO 14001

- The introduction and implementation of ISO 14001:
- Environmental policy,
- Planning,
- Implementation and operation
- Checking, management review, etc.

Applications of EMS

  - Applications EMS in terms of
  - Process flow chart
  - Effluent Generation
  - Composition and treatment of effluents from following industries – sugar, pulp and
  - paper, electroplating, dairy, oil refineries, etc.

Environmental Auditing

- Introduction
- Category “A” & “B” types of projects
- Procedures and Guidelines to conduct Environmental Audit

Environmental Management in Process Industries

- Status of environmental management
- Current Development
- Global environmental challenge
- Stress on environmental health
- Source reduction

- Promote integrated complexes
- Review existing control limits for Pollutants
- Harness environmental biotechnology
- Municipal solid waste
- Reduce emission of greenhouse gases
- Ensure water availability
- Develop pollution inventory database
- Hazardous waste disposal
- Environmental Health education
- Disaster mitigation
- Addressing Challenges: National Environmental Policy
- Cost management in Process industry

Labs/ Practical:

The course practical/ labs should be defined and synchronized with the course outline.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/ Quizzes, Tutorials, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/ Field visits, Group discussion, Report Writing.

Assessment:

Mid-exam, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam/assessment.

Recommended Books

1. Rickson, R.E., 2015. Evaluating environmental and social impact assessment in developing countries.
2. Hanley, N. and Bhatia, S.C., 2011. Pollution control in chemical and allied industries. Alkem Company.
3. Weston, J., 2014. Planning and environmental impact assessment in practice. Routledge.
4. Smith, L.G., 2014. Impact assessment and sustainable resource management. Routledge.

13.5 Elective Multi-Disciplinary Courses

Course ID	Course Title	Cr. Hrs	Theory	Prac.	Total
SEE-301	Wastewater Engineering	3(2-1)	2	1	3
FMP-402	Alternate and Renewable (ARE)	3(2-1)	2	1	3
MDE-XXX	Occupational Health and Safety (Mandatory)	3(2–1)	2	1	3

MDE-XXX Occupational Health and Safety 3(2-1)

Course Description: This course introduces the student to the study of workplace occupational health and safety. The student will learn safe work practices in offices, industry and construction as well as how to identify and prevent or correct problems associated with occupational safety and health in these locations as well as in the home.

Course Outline:

(1) Health and safety foundations:

(a) Nature and scope of health and safety

(b) Reasons/benefits and barriers for good practices of health and safety

€ Legal frame work and OHS Management System

(2) Fostering a safety culture:

(a) Four principles of safety- RAMP (Recognize, Assess, Minimize, Prepare)

(b) Re-thinking safety-learning from incidents

(c) Safety ethics and rules

(d) Roles and responsibilities towards safety

(e) Building positive attitude towards safety

(f) Safet

y cultures in academic institutions

(3) Recognizing and communicating hazards:

(a) Hazards and Risk

(b) Types of hazards: Physical (mechanical and non-mechanical), Chemical (Toxic and biological agents), electrical, fire, construction, heat and temperature, noise and vibration, falling and lifting etc.

(c) Learning the language of safety: Signs, symbols and labels

(4) Finding hazard information

(a) Material safety data sheets

(b) Safety data sheets and the GHS (Globally Harmonized Systems)

(5) Accidents & Their Effect on Industry

(a) costs of accidents

(b) time lost (c) work injuries, parts of the body injured on the job (d) chemical burn injuries (e) Construction injuries

(f) Fire injuries

(6) Assessing and Minimizing the Risks from Hazards

(a) Risk Concept and Terminology

(b) Risk assessment procedure
€ Risk Metric's
(d) Risk Estimation and Acceptability Criteria
€ Principles of risk prevention
(f) Selection and implementation of appropriate Risk controls
(g) Hierarchy of controls

(7) Preparing for Emergency Response Procedures

(a) Fire
(b) Chemical Spill
€ First Aid
(d) Safety Drills / Trainings:

- Firefighting
- Evacuation in case of emergency

(8) Stress and Safety at Work environment

(a) workplace stress and sources
(b) human reaction to workplace stress
€ measurement of workplace stress
(d) shift work, stress and safety
€ improving safety by reducing stress
(f) stress in safety managers
(g) stress and workers compensation

(9) Incident investigation

(a) Importance of investigation
(b) recording and reporting
€ Techniques of investigation
(d) Monitoring
€ Review
(f) Auditing Health and Safety

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Mid-semester exam, report writing/presentation, assignment, project report, quizzes, end-semester exam

Suggested Books:

1. The A-Z of health and safety by Jeremy Stranks, 2006.
2. The Manager's Guide to Health & Safety at Work by Jeremy Stranks, 8th edition, 2006.
3. Occupational safety and health law handbook by Ogletree, Deakins, Nash, Smoak and Stewarts, second edition, 2008.

13.6 Non-Engineering Courses

13.6.1 Social Sciences Courses

Course ID	Course Title	Cr. Hrs	Theory	Prac.	Total
SSC-305	Sociology for Engineers	2(2-0)	2	0	2
SSC-306	Social Psychology	2(2-0)	2	0	2
SSC-307	Community Services	2(2-0)	2	0	2
SSC-308	Organizational Behavior	2(2-0)	2	0	2
SSC-302	Economics for Engineers	2(2-0)	2	0	2
SSC-309	Professional Ethics	2(2-0)	2	0	2

SSH-305 **Social Psychology** **2(0-2)**

Area Scope:

To impart knowledge of social psychology of attraction; attitudes and prejudice; altruism and aggression; personal and social identities; conformity; group influence and their applications in the real world.

Course Outline:

- Principles of sociology and psychology with emphasis on the individual and his/her reciprocal interaction with groups, basic psychological factors, attribution and perception of others, attitudes and attitudinal change, social attitudes, altruism, helping others, aggression, hurting others, prejudice, disliking others, discrimination and stereotypes,
- language and communication, society and cultures, culture and personality, small groups and their relation to the individual, leadership and group dynamics. Attraction, attitudes and prejudice; altruism and aggression; personal and social identities, conformity, group influence, moral and ethical issues, harassment,
- Corruption and its control, thinking processes and decision making.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Edward Alsworth Ross, “Social Psychology”, Macmillan, 2006
2. Emory Stephen Bogardus, “Essentials of Social Psychology”, Univ. of Southern, California Press, 2006
3. Hewstone, M., & Stroebe, W. (Eds.), “Introduction to Social Psychology”, 3rd ed., Oxford: Blackwell Publishers, 2006
4. Lesko, W.A. “Readings in social psychology General, classic, and contemporary selections, 6th ed., 2006

SSC-XXX **Community Services** **2(0-2)**

Area Scope:

Community service-learning provides a variety of benefits to the students and the community service has a unique way of developing an individual's leadership skills, sense of community, civic ethic, selfesteem, and other personal characteristics. Every service activity benefits a specific individual or group. Whether it is building homes for

the poor, serving victims of chronic or terminal illness, tutoring children, addressing environmental needs or any other service, there is a person or group who ultimately benefits from your time. Finally, the organization where you conduct your service benefits enormously. Volunteers can make important contributions to Community benefit agencies (nonprofit) and government programs in their attempt to deal with the complex and growing needs of society.

Course Outline:

- Develop and implement service programs
- Develop workplace communication strategies
- Analyze impacts of sociological factors on clients in community work and services
- Manage and promote diversity
- Manage legal and ethical compliance
- Facilitate workplace debriefing and support processes
- Reflect on and improve own professional practice
- Manage work health and safety
- Assess co-existing needs
- Coordinate complex case requirements
- Develop, facilitate and review all aspects of case management
- Provide case management supervision
- Undertake project work
- Lead and manage team effectiveness
- Manage personal work priorities and professional development
- Manage meetings

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Schools and Community: The Communitarian Agenda in Education By James Arthur; Richard Bailey, Falmer Press, 2000.
- Studying Service-Learning: Innovations in Education Research Methodology by Shelley H. Billig, Alan S. Waterman , Lawrence Erlbaum Associates, 2003

SSC-306 Organizational Behavior 2(0-2)

Course Outline:

- Introduction to Organizational Behavior, Organizational Disciplines and topics
- Psychological Perspective, Social-Psychological Perspectives
- Structure and Control in Organization
- Introduction of Bureaucracy, Managerial Work
- Contingency theory
- Organizational Design
- Individual and Work Learning, Learning Theories, Learning and Work
- Stress, Types of Stress and Work, Occupational Stress Management, Individual Differences
- Personality and its factors o Personality dimensions and social learning Intelligence
- Motivation and Job Satisfaction, Needs at Work, Theories of Motivation and job satisfaction, Corelates of Job satisfaction, Correlates of Job satisfaction

- Group and Work, Social Interaction
- Dramaturgy and impression Management
- Social Skill
- Group and Inter group Behavior, Group Structure & Norms, Group Processes
- How throne Studies
- Leadership
- Leadership as an attribute
- Leadership Style
- Patterns of Work
- Work-the classical approach
- Marx, Weber, & The critique of labor
- Foucault & Disciplinary Power
- Conflict and Consent in Work
- The labor Process debate
- Work place control and resistance
- Industrial conflict and industrial relations
- Organizational culture
- Organizational culture and strategic management
- Exploring organizational culture
- Evaluating concept of culture

Teaching Methodology (Proposed as applicable):

- Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

- Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Finchan, R., & Rhodes, P. (2003), Principles of Organizational Behaviour, 3rd Oxford.
2. Noe, R., Hollenbeck, J. Gerhart, B., & Wright, P. (2006), Human Resource Management, 5th ed., McGraw Hill.
3. Newstrom John W. (2007), Organizational Behaviour, (12th Ed), McGraw Hill.
4. Luthan Fred, (2005), Organizational Behaviour, McGraw Hill Inc.
5. Robins, Stephen, (2005), Organizational Behaviour, McGraw Hill Inc.

SSC-307 Professional Ethics 2(0-2)

Area Scope:

The objective of this course is to grasp ideals and principles as they have been spelled out in a variety of traditional ethical systems and to apply these conceptual structures and guidelines to major problems and dilemmas of engineering practices in a corporate culture.

Outlines:

- Engineering Ethics, Ethical concepts, and Types
- Moral Autonomy, Kohlberg's & Gilligan's Theory
- Profession and Professionalism
- Moral Reasoning, Ethical Theories
- Critique codes of ethics

- Moral frameworks, Personal commitments and professional life
- Engineering as social experimentation
- Involving the public in the design process, Case studies for engineering as social experimentation
- Assessment of safety and risk, Design considerations, uncertainty
- Risk-benefit analysis, Safe-exit and fail safe systems
- Case Studies for the Design Process Case studies in impact of safety/risk on design
- Employee/employer rights and responsibilities
- Confidentiality and conflict of interest
- Whistleblowing, case studies on professional behavior/policies on the job
- Environment, sustainable development, Multinational corporations, globalization of engineering

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Ethics in Engineering 4th edition, by Mike W. Martin, Roland Schinzinger, McGraw-Hill, New York, 2005.
2. Fundamentals of Engineering Economics, 3rd ed., by Chan S. Park
3. Engineering Ethics: Concepts and Cases,4th edition, by Charles E. Harris, Michael S. Pritchard, Michael J. Rabins, Wadsworth, 2008.
4. The Seven Habits of Highly effective people by Stephan r. Covey
5. Principle Centered Leadership Stephan r. Covey
6. Change your lens change your life by (Faiez H. Seyal)
7. How to Manage by Ray Wild
8. Happiness by Richard Layard

13.6.2 **Electives for Management Sciences Courses**

Course ID	Course Title	Cr. Hrs	Theory	Prac.	Total
MSC-302	Engineering Project Management	2(2-0)	2	0	2
MSC-XXX	Principles of Management	2(2-0)	2	0	2

MSC-XXX	Engineering Management	2(2-0)	2	0	2

MSC-302 Engineering Project Management 2(2-0)

Area Scope:

The primary objective of this course is to get the fair understanding of core issues pertaining to Engineering Project Management. This course is aimed at providing both basic and some advanced exposure to emerging trends in the field of Project Management, so as to enable the engineering professionals of tomorrow to successfully complete sophisticated projects within the constraints of capital, time, and other resources with due regards to stakeholders set of expectations. Engineering students will learn key Project Management skills and strategies and will be able to face emerging challenges.

Core Objectives of this course are:

- To develop competencies in project costing, budgeting, and financial appraisal;
- To gain exposure to project Planning Control and Management, using standard tools and schedule variance analysis;
- To appreciate the elements of risk and quality in hi-tech projects;
- To learn Project Management by "practice", through the medium of "End of Semester Group Project"; and appreciate and understand the use of computers in Project Management, especially a tool like MS Project & Primavera etc.

Course Outline:

- **Project Management Concepts**
  History of Project Management, Introduction to Project Management, Project, Program & Portfolio Management, Project characteristics, Objectives& Requirements, Project Phases/Stages, Project Life Cycle, Project Environment, Project Scope & Project Charter, Project Manager, Project Stakeholder Analysis.
- **Project Proposal Development**
  Project Proposal, Characteristics of good proposal, Types of Proposals, Request for Proposal, Request for Quotation etc). Proposal Templates etc.
- **Project Feasibility**
  Brief review of various aspects of Project Feasibility like Technical, Social, Managerial, Economic, Financial & Marketing, Administrative etc.
- **Project Selection Criteria (Economic Analysis of Engineering Projects)**
  Using Break Even Analysis, Cost Benefit Ratio, Internal Rate of Return, Net Present Value etc.
- **Project Contract & Procurement Management**
  Engineering contracts, Type of contracts, understanding of procurement Process & Cycle, PPRA Rules
- **Project Planning and Scheduling**
  - Project Planning (Resource & HR Planning), Work Breakdown Structure, Project Network & Scheduling, Manning Schedule and Activity Charts, Critical Path Method (CPM)/Project Evaluation & Review Techniques
- **Project Costing & Estimation**
  Cost Estimation in Projects, Cost components in projects and methods for cost estimation in projects, Cost Control in Projects, Estimation of Outstanding Work, Earned Value Management, Schedule & cost variance analysis

- **Project HRM & Communication Management**

  Effective organization and communication for Successful Projects, Project Organizational Structures (Project matrix and project based organizations), Project HR Plan preparation, HR Need Assessment and HR Matrix, Building and Managing effective project team, Selection & control mechanism of HRM in Projects, Effective Communication Plan.

- **Project Risk Management**

  Definitions Project Risk, Project Risk Management Tools, Types of Project Risk, Project Risk Assessment, Risk Identification and Mitigation, Monitoring & Controlling Risk, Generic Risk Management Strategies & Technique.

- **Computer Application in Project Management**

  Basic/Elementary Introduction and hands on basic exposure of use of MS Project & Primavera P6 Software in Project Management

- **Project Quality Management**

  Defining Quality, Quality Assurance, Quality Management, 7 Quality Improvement Tools as applied to Project Management, Project Quality Management Plan, Quality Management Processes and Strategies

- **Project Closure & Termination**

  Project Evaluation, defining project success, Project Completion Criteria, Project Audit, Project Termination &When to close a project, the termination process, Project Close Up & lesson learnt, & Project Archive

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Project Management: A system Approach to Planning, Scheduling and Controlling 11th Edition, Harold Kerzner
2. Bennett, F. Lawrence. 1996. *The management of engineering*. New York: Wiley.
3. Cleland, David. *Field guide to project management.* New York: Wiley.
4. Eisner, H. *Essentials of project management and systems engineering management*. New York: Wiley.
5. Frame, J. D. *Managing projects in organizations*. San Francisco: Jossey-Bass
6. Goldratt, Eliyahu. *Critical* chain. North River Press.
7. Haynes, M.E. *Project management: From idea to implementation*. Los Altos, CA: Crisp Publications.
8. Lewis, James, *Project planning, scheduling & control*. New York: McGraw-Hill
9. Lewis, James, P. 1998. *Mastering project management*. New York: McGraw-Hill
10. Lientz, Bennet & Rea, Kathryn. 1995. *Project management for the 21st century*. San Diego: Academic Press.
11. Miller, Roger & Lessard, Donald. 2000. *The strategic management of large engineering projects.* Cambridge, MA: MIT Press.
12. Nicholas, J.M. *Managing business & engineering projects*. Englewood Cliffs, NJ: Prentice Hall.

13. Shtub, Avraham, Bard, Jonathan, & Globerson, Shlomo. 1994. *Project management: Engineering, technology, and implementation.* Englewood Cliffs, Prentice-Hall.
14. Project Management by Adrienne Watt
15. J.R. Meredith and S.J. Mantel. Project Management: A Managerial Approach. John Wiley and Sons. New York. 2019. (Reference).

MSC-XXX Principles of Management 2(2-0)

Area Scope

- The focus will be on the learning fundamental principles of management and of managing people and organization.
- Develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international organizations.

Course Contents:

- Introduction, overview and scope of discipline
- The evolution and emergence of management thought
- Management functions
- Planning concepts, objectives, strategies and policies
- Decision making
- Organizing; departmentalization, line/staff authority, commitments and group decision making
- Staffing: principles of selection, performance, career planning
- Leading: Motivation, leadership, communication
- Controlling: the system, process and techniques of controlling
- Management and Society: future perspective

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. Stephen P. Robins, Mary Coulter: Management, latest edition.
2. H. Koontz Odonnel and H. Weihrich: Management, latest edition.
3. Mc Farland: Management: Foundation and Practice, latest edition.
4. Robert M. Fulmer: The New Management, latest edition.

MSC-XXX Engineering Management 2(2-0)

Course Outlines

- Industrial networks
- Fundamentals of Product and Process development
- Business Community and New Generations of Managers
- Practical Skills Knowledge and Experience in Commercialization of New Technological Inventions
- Use of Multidisciplinary Science Based Knowledge,
- Problem Solving, Teamwork and Outreach Activity,

- Major steps in proof of concept to intellectual property protection,
- Prototype development
- Fabrication and assembly routes
- Materials procurement,
- Identification and creation of new markets
- Development of business plan
- Appropriate technology and marketing
- Distribution and financing
- Routes and strategies for specific technology under development.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing.

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

1. R. A. Bulgelman, Strategic Management of Technology and innovation, latest Edition McGraw Hill.

14 Complex Engineering Problem

14.2 Definition of Complex Engineering Problem

Engineering problems which cannot be resolved without in- depth engineering knowledge, and have some or all the characteristics listed below:

Attribute	Complex Problem
Depth of knowledge required	Cannot be resolved without in-depth engineering knowledge at the level of one or more of WK3, WK4, WK5, WK6 or WK8 which allows a fundamentals-based, first principles analytical approach.
Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering and other issues.
Depth of analysis required	Have no obvious solution and require abstract thinking and originality in analysis to formulate suitable models.
Familiarity of issues	Involve infrequently encountered issues.
Extent of applicable codes	Outside problems encompassed by standards and codes of practice for professional engineering.
Extent of stakeholder involvement and needs	Involve diverse groups of stakeholders with widely varying needs.
Interdependence	High level problems including many component parts or sub-problems.

14.3 Definition of Complex Engineering Activities

Complex activities mean (engineering) activities or projects that have some or all of the following characteristics listed below:

The attributes of complex engineering activities, some of which might reasonably be encountered by a professional engineering undergraduate (e.g. during capstone design or a period of industry experience) are defined as follows:

Attribute	Complex Activities
Range of resources	Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies).
Level of interactions	Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues.
Innovation	Involve creative use of engineering principles and research-based knowledge in novel ways.
Consequences to society and the	Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation.

Familiarity	Can extend beyond previous experiences by applying principles-based approaches.

-

14.4 Rubrics for Assessment of Complex Engineering Problems

Sr. No.	Indicators of Assessment	Attributes Assessed	Levels of Achievement			
			Poor (0 Marks)	**Fair (1-2 Marks)**	**Good (3-4 Marks)**	**Excellent (5 Marks)**
1	**Problem Identification**	✓ Depth of knowledge required	Demonstrates an inability in identifying a problem-statement or related contextual factors	Demonstrates a limited ability in identifying a problem-statement or related contextual factors	Demonstrates the ability to construct a problem statement with evidence of most relevant contextual factors, but problem statement is not complete	Demonstrates the ability to construct a clear and insightful problem statement with evidence of all relevant contextual factors
2	**Select Appropriate Technique and Equipment / Tools**	✓ Range of conflicting requirements ✓ Depth of analysis required	No use of appropriate technique and equipment / tools leading towards major errors in the objective	Unsatisfactory approach for selection of appropriate technique and equipment / tools to achieve desired objective	Satisfactory selection of appropriate technique and equipment / tools to achieve desired objective without proper reasoning.	Relevant and smart selection of appropriate technique and equipment / tools to achieve desired objective along with proper reasoning

3	**Implement the Relevant Standards / Procedures**	✓ Familiarity of issues ✓ Extent of applicable codes ✓ Independence	Unsatisfactory understanding to implement the relevant codes / procedures and familiarity of issues encountered to solve the problem.	Implement the relevant codes / procedures incompletely that solves only some portion of the problem.	Implement the relevant codes / procedures with minor mistakes.	Implement the relevant codes / procedures perfectly.
4	**Analysis and Results**	✓ Extent of stakeholder involvement and level of conflicting requirements ✓ Consequences	No data collected; analysis is not performed or done entirely wrong without the involvement of stakeholder's interests	Inappropriate data collected; no understanding of analysis, and consequences of result interpreted incorrectly with neglectful involvement of stakeholder's interests	Appropriate data collected, but insufficient analysis and results adequately interpreted with slight involvement of stakeholder's interests	Appropriate data collected; correct analysis and results correctly interpreted with satisfactory involvement stakeholder's interests

15 Final Year Design Project (FYDP)

As a partial requirement for the award of undergraduate degree at Bahauddin Zakariya University (BZU), a project culminating in the submission of a project report must be carried out by students in their final year of study.

The project is a module that provides the students an opportunity to design, undertake or conduct an independent piece of research or novel work related to Agricultural Engineering under the guidance of a supervisor, who is a member of the faculty of Department of Agricultural Engineering.

15.2 Objectives of Final Year Design Project

The objectives of FYDP are:

1. To enhance students' abilities in identifying and analyzing of scientific research in the field of Engineering.
2. To improve students' skills of solving complex engineering problems using the proper research methodology.
3. To provide an encouraging platform to the students to work as an individual as well as a team.

15.3 Evaluation of FYDP Course Learning Outcomes (CLOs)

Complete FYDP will comprise on FYDP-I and FYDP-II for 7th semester and 8th semester, respectively. Evaluation Scheme for both of semesters will be as per following. Marking of CLOs is out of 10 in each assessment.

FYDP-I (7th Semester) (100 Marks) (0+3 Cr. Hr.)	**Point of Evaluation/ Assessment Methods**	**Associated CLOs**	**Associated PLOs**
	Proposal Defense Presentation (2nd Week)	CLO-5	PLO-7
	Progress Presentation I (8th Week)	CLO-1, CLO-7, CLO-8, CLO-9	PLO-3, PLO-9, PLO-10, PLO-11
	Progress Presentation II (16th Week)	CLO-2, CLO-3, CLO-6, CLO-7, CLO-9	PLO-4, PLO-5, PLO-8, PLO-9, PLO-11
FYDP-II (8th Semester)	Progress Presentation III (7th Week)	CLO-2, CLO-3, CLO-6, CLO-9	PLO-4, PLO-5, PLO-8, PLO-11
	Final Demonstration (14th Week)	CLO-4, CLO-5, CLO-8	PLO-6, PLO-7, PLO-10

(100 Marks) **(0+3 Cr. Hr.)**	Final Progress Presentation (16th Week)	CLO-1, CLO-8, CLO-10	PLO-3, PLO-10, PLO-12

Breakdown of total marks in Final Year Design Project for Supervisor, FYDP Internal Committee and External Member.

Semester	Supervisor	FYDP Internal Committee	Total
7th	70	30	100
8th	70	30	100

15.4 Final Year Design Project (FYDP) Evaluation Rubrics

Evaluation Rubrics				
CLOs	**Excellent** (8-10 Marks)	**Good** (6-7 Marks)	**Fair** (4-5 Marks)	**Poor** (0-3 Marks)
CLO-1 **(Project Design and Implementation)** **[C5]** **[PLO-3]**	Comprehensive design with justified subcomponents of the project resulting in desired outcomes	Design with lacking of justification for subcomponent but resulting in desired outcomes	Design with flaws resulting in roughly estimated outcomes	Random design without logics resulting in random outcome
CLO-2 **(Analyses and Investigate engineering data)** **[C6]** **[PLO-4]**	Effectively analyzed the outcomes of the project at different levels of implementation, interpreted and drawn useful conclusion	Analyzed the outcomes of the project with basic level of interpretation and conclusion	Weak analysis of the project outcomes without useful conclusions	Unable to analyze the outcome of the project
CLO-3 **(Modern tools usage)** **[P4]** **[PLO-5]**	Usage of the tools shows a complete awareness of the tools' capabilities and features	Usage of the tools at basic level for completion of the project	Deficiencies in usage of the tools hindering well defined outcomes of the project	Poor usage of the tools resulting erroneous outcomes or no outcomes at all

CLO-4 **(Project value in Society)** **[A3]** **[PLO-6]**	Project encompasses comprehensive societal benefits with recent trends	Project is valuable for society but does not cover the modern trends	Project may be valuable for society with little contributions	Project has no usefulness for the society
CLO-5 **(Environment and Sustainability)** **[A3]** **[PLO-7]**	Project well encompasses the environmental impacts and contributes towards sustainability	The project has considerations for environmental sustainability	The project considers the environment and sustainability issue to some extent	Project does not include environmental and sustainability considerations
CLO-6 **(Professional Ethics)** **[A4]** **[PLO-8]**	Completely followed ethical norms while executing and reporting the project	Followed ethical norms during execution with minor deficiencies in reporting	Casual behavior during execution, reporting and acknowledgment	Did not followed ethical norms with copied design with plagiarized reports
CLO-7 **(Team role)** **[A3]** **[PLO-9]**	An effective team member by taking initiatives and encouraging behavior	An effective team member with responsible behavior but limited to the tasks assigned	A passive team member limited to assigned task require constant reminders	A passive team member with little effectiveness in the team
CLO-8 **(Writing and presentation skills)** **[A4]** **[PLO-10]**	Impressive presentation and technical writing skills	Good presentation skills with sufficient technical writing	Fair presentation skill with poor technical writing	Poor presentation and writing skills
CLO-9	Efficient resource management with strict compliance of the timelines	Strict compliance of the timelines without	Missing timelines without resource management	Resources wastage without

(Project management and timeline) **[A4]** **[PLO-11]**		resource management		meeting any timelines
CLO-10 **(Life-long learning)** **[A3]** **[PLO-12]**	Incorporate innovative solutions leading towards futuristic development	Incorporate the innovative solutions of the contemporary era	Little futuristic approach incorporated in the project	Incorporate conventional solution without futuristic approach

16 Feedback Survey Forms

16.2 Alumni Feedback Survey Form

The Board of Studies in Agricultural Engineering in its meeting held on 26th May 2022 updated the Alumni Feedback Survey Forms

16.2.1 Alumni Feedback Survey Form For PLOs

16.2.2 Alumni Feedback Survey Form for PEOs

ALUMNI FEEDBACK SURVEY FORM FOR PLOs

BAHAUDDIN ZAKARIYA UNIVERSITY, MULTAN, PAKISTAN

DEPARTMENT OF AGRICULTURAL ENGINEERING

The purpose of the survey is to assess the quality of undergraduate academic program during your stay at the Department of Agricultural Engineering. Your response will help us to achieve Program Learning Objectives (PLOs) and continual improvements in the quality of the curriculum.

Name _____

Session: _____

Company/Business Name and Address:_____

Designation: _____

Email: _____

Phone No: _____

Evaluate the following aspects by encircling the number that best reflects your experience.

1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree

Statement	**PLO**	**1**	**2**	**3**	**4**	**5**
I was trained to apply the knowledge of engineering fundamentals to solve complex engineering problems.	**1**					
The courses studied by me was sufficient to identify, formulate, and analyze complex engineering problems	2					
The courses studied by me was sufficient to design solutions for complex engineering problems	**3**					
The courses studied by me was sufficient to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments.	4					
The courses studied by me was sufficient to create, select and apply appropriate techniques, modern engineering and IT tools to complex engineering activities with an understanding of the limitations	5					
I was trained to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice	6					
I was trained to understand the impact of professional engineering solutions in societal and environmental contexts and need for sustainable development.	7					
I was trained to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.	8					
I was trained to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings	9					
I was trained to communicate effectively, orally as well as in writing, on complex engineering activities with the engineering community and with society at large	10					
I was trained to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to	11					

manage projects in a multidisciplinary environment.						
I was trained to recognize importance of and pursue lifelong learning in the broader context of innovation and technological developments	12					

Any suggestions to improve Agricultural Engineering Curriculum

_____

_____

_____

ALUMNI FEEDBACK SURVEY FORM FOR PEOs

BAHAUDDIN ZAKARIYA UNIVERSITY, MULTAN, PAKISTAN

DEPARTMENT OF AGRICULTURAL ENGINEERING

The purpose of the survey is to assess the quality of undergraduate academic program during your stay at the Department of Agricultural Engineering. Your response will help us to achieve Program Education Objectives (PEOs) and continual improvements in the quality of the curriculum.

Name _____

Session: _____

Company/Business Name and Address:_____

Designation: _____

Email: _____

Phone No: _____

Evaluate the following aspects by encircling the number that best reflects your experience.
1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree

	PEOs	1	2	3	4	5
1. The courses studied by me was relevant to my professional life.	2					
2. The contents of the Syllabus were revised at reasonable intervals	1					

3. The knowledge gained was enough to give me confidence for self-employment	2					
4. The syllabus imparted value based learning in terms of skills, concepts, knowledge and critical thinking in students	1					
5. Aims and objectives of the syllabus were well defined and clear to the teachers and students	1					
6. The prescribed books were relevant, updated and appropriate	1					
7. The syllabus was directly related to enhancing practical competencies	3					
8. The syllabus was need based as per the requirement of the job/industry	3					

16.3 Employer Feedback Survey Form

EMPLOYER FEEDBACK SURVEY FORM

This survey is concerning BZU graduated employee at your prestigious organization. Your contribution helps us in evaluating our program in the scenario of Outcome Based Education System (OBE).

- Name of the Organization:
  _____
- Category of organization (Operation / Academics / Services):
  _____
- Key responsibility of BZU graduate
  _____

Please specify your observed score for the attributes 1 to 5 given below on the basis of the following scale below:

Excellent=5	**Good=3-4**	**Fair=1-2**	**Poor=1**

	Questionnaire	**Score**
	1. Has the employee processes strong core mathematical and engineering concepts in the do of Agricultural Engineering?	
	2. Has sufficient skills to analyze the problems of real-world challenges?	
	3. Has decision making capability to work under pressure and well manage the task at hanc	

	4. Has capability to be an effective member of the team as well as good leadership attribute	
	5. Possess soft skills required for the job?	
	6. Is responsible and ethical professional?	
	7. Has proposed innovative solutions related to contemporary engineering problems?	
	8. Well addressed societal and environmental concerns while undertaking engineering task	
	Please state further remarks and observations you like to share with us to enhance the skills of our graduates.	

Note: Attach extra sheet if necessary.

16.4 Internship Feedback Survey Form

The Board of Studies in Agricultural Engineering in its meeting held on 26th May 2022 updated the Internship Feedback Survey Forms

16.4.1 Internship Evaluation Form (To be filled by the employer)

16.4.2 Internship Evaluation Form (To be filled by the intern)

BAHAUDDIN ZAKARIYA UNIVERSITY, MULTAN, PAKISTAN

DEPARTMENT OF AGRICULTURAL ENGINEERING

Internship Evaluation Form

(To be filled by employer)

Name of Intern: _____

Registration No. of Intern: _____

Department: _____

Organization/Firm: _____

Assignment/Job: _____

Supervisor: _____

Evaluate the following aspects by encircling the number that best reflects your experience.

1 = Unsatisfactory; 2 = Satisfactory; 3 = Good; 4 = Very Good; 5 = Excellent 6 = Not Applicable

1. Engineering Knowledge	**1**	**2**	**3**	**4**	**5**	**6**
2. Problem Analysis	**1**	**2**	**3**	**4**	**5**	**6**
3. Design/Development of Solutions	**1**	**2**	**3**	**4**	**5**	**6**
4. Investigation	**1**	**2**	**3**	**4**	**5**	**6**
5. Modern Tool Usage	**1**	**2**	**3**	**4**	**5**	**6**
6. The Engineer and Society	**1**	**2**	**3**	**4**	**5**	**6**
7. Environment and Sustainability	**1**	**2**	**3**	**4**	**5**	**6**
8. Ethics	**1**	**2**	**3**	**4**	**5**	**6**
9. Individual and Teamwork	**1**	**2**	**3**	**4**	**5**	**6**
10. Communication	**1**	**2**	**3**	**4**	**5**	**6**
11. Project Management	**1**	**2**	**3**	**4**	**5**	**6**
12. Lifelong Learning	**1**	**2**	**3**	**4**	**5**	**6**

Overall Performance Rating:

Unsatisfactory Satisfactory Good Very Good Excellent

Employer's Signature & Seal

BAHAUDDIN ZAKARIYA UNIVERSITY, MULTAN, PAKISTAN

DEPARTMENT OF AGRICULTURAL ENGINEERING

Student's Internship Evaluation Form

(To be filled by intern)

This form is for you (the student) to assess your internship experience. ***At the conclusion of the internship, by the end of the semester, complete this form and submit it to your internship coordinator.***

Internship Department: _____

Sponsoring Supervisor: _____

Job/Assignment: _____

Encircle the number that best reflects your level of agreement/disagreement with each of the following statements.

1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; 5 = Strongly Agree

I achieved my learning goals during the internship.	**1**	**2**	**3**	**4**	**5**
Through my duties, I received training in a profession/field related to my	**1**	**2**	**3**	**4**	**5**
I experienced some of the realities of working in the profession/field.	**1**	**2**	**3**	**4**	**5**
I successfully completed my assigned responsibilities and duties.	**1**	**2**	**3**	**4**	**5**

Evaluate the following aspects of your internship by encircling the number that best reflects your experience.

1 = Unsatisfactory; 2 = Satisfactory; 3 = Good; 4 = Very Good; 5 = Excellent

Work Environment:

Clarity of organizational structure	**1**	**2**	**3**	**4**	**5**
Access to necessary materials and/or equipment	**1**	**2**	**3**	**4**	**5**
Collegiality/friendliness of the employees	**1**	**2**	**3**	**4**	**5**
Attitude of respect for interns	**1**	**2**	**3**	**4**	**5**

Support and Feedback:

From your supervisor	**1**	**2**	**3**	**4**	**5**
From other employees with whom you interacted	**1**	**2**	**3**	**4**	**5**

Opportunity to be Creative:

Willingness of others to consider your ideas	**1**	**2**	**3**	**4**	**5**

BAHAUDDIN ZAKARIYA UNIVERSITY, MULTAN, PAKISTAN

DEPARTMENT OF AGRICULTURAL ENGINEERING

Interaction with Others:

Opportunity to contribute to a team project	**1**	**2**	**3**	**4**	**5**
Questions were encouraged and answered.	**1**	**2**	**3**	**4**	**5**
Access to one or more mentors (supervisor or employees)	**1**	**2**	**3**	**4**	**5**

Overall Evaluation of Internship: ***Unsatisfactory Satisfactory Good Very Good Excellent***

Additional Comments (if any):

Intern's Name:

Registration No.

Contact No.

Signature:

E-mail:

16.5 Student Course Evaluation Survey Form

**** The survey form is updated by the Board of Studies in Agricultural Engineering in its meeting held on 26th May 2022**

Student Course Evaluation Questionnaire

(To be filled by each Student at the time of Course Completion)

Degree Name: **BSc Agricultural Engineering**
Semester: _____
Session: _____
Course Title and No. _____

	Poor	Fair	Satisfactory	Very good	Excellent
Level of effort you put into the course	○	○	○	○	○
Level of skill/knowledge at start of course	○	○	○	○	○
Level of skill/knowledge at end of course	○	○	○	○	○
Contribution of course to your skill/knowledge	○	○	○	○	○
Instructor was an effective lecturer/demonstrator	○	○	○	○	○
Instructor stimulated student interest	○	○	○	○	○
Instructor effectively used time during class periods	○	○	○	○	○
Instructor was available and helpful	○	○	○	○	○
Learning objectives of the course were clear	○	○	○	○	○
Course content of the subject was organized and well planned	○	○	○	○	○

16.6 Student Feedback Survey Form

Students Feedback Survey

(To be filled out by all students in every Mid/Final semester)

Please give us your views so that Course quality can be improved. You are encouraged to be frank and constructive in your comments.

A: Excellent B: Very Good C: Good D: Fair E: Poor

1. Depth of knowledge and thorough preparation.

   A B C D E

2. Communication skills, explanation, clearance of students' doubts and confidence in delivery.

   A B C D E

3. Frequency and usefulness of assignments, their grading, timely return, and discussion on the same.

   A B C D E

4. Impartial, honest, and fair grading and conveyance/display of grades/results as per schedule.

   A B C D E

5. Issue of handouts/relevant material for support and understanding of the course/subject/project.

   A B C D E

6. Innovation and versatility in making course/subject/project interesting and understandable.

   A B C D E

7. Discussion about new ideas, techniques, and latest information, relevant to the course/subject/project.

   A B C D E

8. Time/duration and conduct of test/examination, and standard of invigilation.

   A B C D E

9. Fairness in the conduct of quiz/spot/lab tests/midterm examination, etc.

   A B C D E

10. Interpersonal relationship and level of patience while dealing with students and their problems.

A B C D E

11. Availability and guidance during office hours.

A B C D E

12. You may submit additional comments and feedback below:

_____

_____
_____
_____
_____
_____
_____

13. Utilization of Learning Management System (LMS) to support course teaching (if applicable)

_____
_____
_____
_____
_____
_____
_____

16.7 Student Exit Survey Form

EXIT SURVEY

Congratulations upon successfully completing the degree requirements for B.Sc. Agricultural Engineering from BZU. Your assessment will help in continuous improvement of the program.

- Name of Student:
  _____
- Registration No:
  _____
- Department:
  _____
- Contact No:
  _____

Please rank your observed score for the attributes 1 to 5 given below on the basis of the scale provided below;

Excellent=5	Good=3-4	Fair=1-2	Poor=1

Questionnaire		Score
	1. Are you satisfied with theoretical and practical knowledge gained during B.Sc. Agricultural Engineering?	1
	2. Has the program polished your skills to analyze the complex engineering problems?	2
	3. Do you feel confident that you can develop solutions for the problems related to Agricultural Engineering in a in a systemic way?	3
	4. Has the program provided you with enough opportunities to explore, interpret and conclude Agricultural systems?	4
	5. How good are you in using of instruments and tools related to your field of study?	5
	6. Have you designed some projects focusing to provide solutions for the local commu	6
	7. Has the program provided you with enough opportunities to work with the sustainab development goals?	7
	8. Has the program developed the skills of planning a project in a multidisciplinary environment?	11
	9. Has the program offered you enough opportunities for team building and group activities?	9
	10. Is the program conducive in refining ethical values of its graduates?	8
	11. Do you think the program has polished your convincing arguments capabilities?	10
	12. Do you feel quest for further exploration in your field of study?	12
	Please state further remarks and observations you like to share with us to enhance the skills of our graduates.	

Department of Agricultural Engineering
Faculty of Agricultural Sciences and Technology
Bahauddin Zakariya University
Multan (60800) Pakistan

RUBRICS FOR LAB PERFORMANCE ATTENDANCE

Each week, students will be assessed in the lab based on following criteria:

1. Lab Participation
2. Lab Performance
3. Lab Report
4. Lab Safety
5. Viva

The points each week will be totaled and combined with other assignment and or assessments to account for 40 to 50% of the total course grade (Practical). Extra credit opportunities may arise throughout the semester which can be used to replace a low assessment.

Lab Performance Assessment

Sr. No.	Criteria	Weightage
1	Lab Participation	1/5 of course grade (Practical)
2	Lab Performance	1/5 of course grade (Practical)
3	Lab Report	1/5 of course grade (Practical)
4	Lab Safety	1/5 of course grade (Practical)
5	Viva	1/5 of course grade (Practical)

9 LAB RUBRICS

Approved by the Board of Studies in Agricultural Engineering in its meeting held on 26th May 2022 on the recommendation of the Departmental Curriculum Learning Process Committee.

Department of Agricultural Engineering, FAS&T
Bahauddin Zakariya University, Multan (60800) Pakistan

1. Lab Participation Rubric (Weightage: 1/5 of course Practical grades)

Proficient (3)	Adequate (2)	Substandard (1)	Unacceptable (0)
Student demonstrates an accurate understanding of the lab objectives and concepts. The student can correctly answer questions and if appropriate, can explain concepts to fellow classmates. Student is eager to participate and assists when needed.	Student arrives on time to lab, but may be unprepared. Answers to questions are basic and superficial suggesting that concepts are not fully grasped.	Student tardiness or unpreparedness makes it impossible to fully participate. If able to participate, student has difficulty explaining key lab concepts.	Student was absent from lab or did not participate. There was no attempt to make prior arrangements to make up the lab.

2. Lab Performance Rubric (Weightage: 1/5 of course Practical grades)

Proficient (3)	Adequate (2)	Substandard (1)	Unacceptable (0)
Demonstrates very good knowledge of the lab procedures Gladly helps other students to follow procedures Thoroughly and carefully follows each step before moving on to next step	Demonstrates general knowledge of lab procedures Requires help from teacher with some steps in procedures	Demonstrates good knowledge of the lab procedures Will ask peers for help with problems in lab procedures Works to follow each step before moving on to the next step	Lacks the appropriate knowledge of the lab procedures Often requires help from the teacher to even complete basic procedures

3. Lab Report Rubric **Weightage: 1/5 of course Practical grades)**

Proficient (3)	Adequate (2)	Substandard (1)	Unacceptable (0)
Demonstrates very good knowledge of the lab procedures Gladly helps other students to follow procedures Thoroughly and carefully follows each step before moving on to next step	Demonstrates general knowledge of lab procedures Requires help from teacher with some steps in procedures	Demonstrates good knowledge of the lab procedures Will ask peers for help with problems in lab procedures Works to follow each step before moving on to the next step	Lacks the appropriate knowledge of the lab procedures Often requires help from the teacher to even complete basic procedures

4. Lab Safety Rubric **(Weightage: 1/5 of course Practical grades)**

Proficient (3)	Adequate (2)	Substandard (1)	Unacceptable (0)
Proper safety precautions are consistently used Consistently thinks ahead to ensure safety Will often help other students to conduct labs safely	Proper safety precautions are generally used May need to be reminded once during the lab	Proper safety precautions are often missed Needs to be reminded more than once during the lab	Proper safety precautions are consistently missed Needs to be reminded often during the lab

5. Viva **(Weightage: 1/5 of course Practical grades)**

Proficient (3)	Adequate (2)	Substandard (1)	Unacceptable (0)
Questions are answered completely and correctly. Very well confident Dress properly	Questions are answered fairly well Fairly confident	Student has problems with the answers. Student is confused	Answers by the student are incorrect Lacking confidence

Pakistan Engineering Council

(Constituted under Pakistan Engineering Council Act, 1976 enacted by the Parliament)

Engineering Accreditation Department

Ataturk Avenue (East),
G-5/2, Islamabad

PEC/EAD/P&C/UEP/2023

September 27, 2023

To:

All Vice Chancellors/ Rectors/ Heads of
HEIs in Pakistan.

Subject: **Adoption of HEC Undergraduate Policy (UEP) for Undergraduate Engineering Degree Programs**

Ref: HEC Notification No.15-54/Coord/2019/HEC/(CURR/UEP/578 dated July 13, 2023.

Dear Sir/ Madam,

PEC in its 110th meeting of Engineering Accreditation Board (EAB) held on August 2, 2023 considered the subject policy and constituted a Sub-Committee for finalizing the recommendations for engineering programs after thorough deliberations. The approved PEC Engineering Education Guidelines duly approved and incorporating HEC UEP are as under for Undergraduate Engineering Programs w.e.f. Fall-2023 and onwards:

a. PEC Engineering Education Guidelines - **Annex-A**.
b. Existing and Proposed Courses of PEC Framework - **Annex-B**.

2. The Guidelines have also been forwarded to PEC Engineering Curriculum Review & Development Committees (ECRDCs) to incorporate these guidelines in ongoing and future review of Engineering Curricula.

3. Forwarded for information, compliance and implementation, please.

Regards,

Engr. Niaz Ahmed
HoD/ Additional Registrar
Ph: 051-9219050

Encl: as above

Copy to:-

- Chairman/ Executive Director/ Advisor (Acad), HEC
- Convener EAB, PEC
- All ECRDCs
- PS to Chairman / Registrar, PEC
- All PEC Regional/ Branch Offices

Annex-A

PEC ENGINEERING EDUCATION GUIDELINES IN LINE WITH HEC UG EDUCATION POLICY 2023

S#	Description/ Attributes	HEC Policy	Revised PEC Guidelines for Fall-2023 & onwards
1.	Nomenclature	• Bachelor of Science or Bachelor of Studies (BS) • Professional Councils will follow their own approved nomenclature to remain synchronize with their service rules.	• B.E, B.S Engineering and B.Sc Engineering.
2.	Program Credits	• Total=120-144 Credit Hours • General Education: Min 30 (Arts & humanities, Social Sci, Natural Sci, Quantitative Reasoning, Expository Writing, **Computer Courses**, Entrepreneurship, Pak Studies, Islamic Studies/ Ethics) • Major Courses: Min 72 • Minor Courses: Min 12 • Inter-Disc/ Distribution: Min 12	• Total=**130-136** Credit Hours • General Education for Engineering Disciplines = Min **38** (after readjusting non-engineering courses) • Engineering = Min **72** **(Including Computer Courses, foundation, breadth depth/ Major)** • FYDP/ Capstone Project= **06** • Multi-Disciplinary Engineering Courses= Min **06** • **08-14** Credit Hours (Flexible Engineering/ Non Engineering Courses) may be adjusted as per the requirements
3.	Admission	In the Department (In the 1st Semester)	In the program/ department (In the First Semester) As per PEC Regulations for Engineering Education in Pakistan
4.	General Education Courses	HEI may offer during first 4 Semesters.	Spread over 8 semesters/ program
5.	Academic Advisory	Proposed by HEC	Already included in PEC Policies
6.	Guidance on General Education	To be provided by the Curriculum Division, HEC for degrees	To be provided by PEC Curriculum Section
7.	Field Experience (Mandatory)	At-least 06-08 weeks, (preferably undertaken during semester or summer break of 03 Credit Hours (Graded)	Mandatory and qualifying Industrial Internship of **06-08 Weeks** as per PEC Accreditation Manual-2019

8.	Capstone Project (Mandatory)	Till completion of the BS program (03 Credit Hours)	FYDP/ Capstone **(06 Credit Hours)/** *Spread over Final Year (7th & 8th Semester)* The FYDP shall include complex engineering problems and design of systems, components or processes integrating core areas and meeting specified needs with appropriate consideration for public health and safety along with cultural, societal, and environmental considerations encompassing the UN-SDGs. A project of this nature should invariably lead to an integration of the knowledge and practical skills as mandated in the GAs.
9.	Admission in 5th Semester	Allowed (Councils will decide to allow or not)	Not Allowed (as concept of Associate Degree in Engineering Discipline is not approved by PEC)
10.	Exit after 4th Semester	Allowed with Associate Degree (Councils will decide to allow or not)	Not Allowed (as concept of Associate Degree in Engineering Discipline is not approved by PEC)

Annex-B

REVISED COURSES OF PEC FRAMEWORK - 2023
(Inline with HEC UG Education Policy-2023)

Knowledge Profile* (WK-1 to WK-8)*	Knowledge Area	Sub-Area	Courses	Credit Hours	Sub-Area	Courses	Credit Hours
		Existing			Revised		
Non-Engineering Domain							
WK-2	**Natural Science**	Math	As per program requirements	12 – 15	Math	***Quantitative Reasoning-I (or equivalent courses for all Engineering Disciplines)	3
						**Quantitative Reasoning- II (or equivalent courses for all Engineering Disciplines)	3
						***Advanced/ Applied Math Courses (as per requirement of the Engineering Disciplines)	6-9

WK-1		Physics	Applied Physics	6 – 9	Natural Science (Physics, Chemistry, Math)	***Applied Physics	3-9
		Chemistry	Applied Chemistry			***Applied Chemistry	
		Natural Science/ Math Elective	As per program requirements			***Math Elective	
WK-7	**Humanities**	English	Written, communication and presentation skills	4 – 7	English	**Functional English	3
						**Expository Writing	3
		Culture	Islamic Studies and Ethics	2	Culture	**Islamic Studies OR Religious Education/ Ethics in lieu of Islamic studies for non-Muslim students	2
			Pakistan Studies and Global Perspective	2		**Ideology and Constitution of Pakistan	2
						*Arts & Humanities (Languages	2

						or study of religion)	
		Social Science	Social and soft skills	2 – 6	Social Science	***Social Science	2
						**Applications of ICT	5
						**Civics and Community Engagement	
	Management Sciences	Professional Practice	Professional and Project Management	2 – 6	Professional Practice	***Project Management	2
						**Entrepreneurship	2
Total (Non-Engineering Domain)				**Min 30**	**Total (Non-Engineering)**		**Min 38**
Knowledge Profile* (WK-1 to WK-8)	**Knowledge Area**	**Sub-Area**	**Courses**	**Credit Hours**	**Sub-Area**	**Courses**	**Credit Hours**
Engineering Domain							
WK-2/ WK-4/ WK-5/ WK-6/	Computer and Information Sciences	ICT/AI/ Data Science/ Cyber Security		6 – 9	AI/ Data Science/ Cyber Security		6-9
WK-3/ WK-2/	Foundation Engg Courses		Specific to program	22 – 24		Specific to program	22 – 24

			objectives and outcomes			objectives and outcomes	
WK-4/ WK-2/ WK-1/	Core Breadth of Engg discipline		Specific to program objectives and outcomes	23 – 24		Specific to program objectives and outcomes	22 – 24
WK-5/ WK-6/	Core Depth of Engg Discipline		Specific to program objectives and outcome	22 – 24		Specific to program objectives and outcome	22 – 24
				Min 73			**Min 72**
WK-3/ WK-4/ WK-2/ WK-1/	Multidisciplinary Engg Courses		Specific to program objectives and outcome	6 – 12	Specific to program objectives and outcome		6
			Occupational Health and Safety (mandatory- 01 Cr Hr)		Occupational Health and Safety (mandatory- 01 Cr Hr)		
WK-6/ WK-8/ WK-7	Final Year Design Project (FYDP)/ Capstone	Integration of innovative, creative, technical, management and presentation skills of a graduate towards final year.		6	Final Year Design Project (FYDP)/ Capstone		6
WK-6/ WK-7/	Industrial Training	at least 6 - 8 weeks internship		Qualifying	Internship (06-08 Weeks)		Mandatory & Qualifying

WK-4/ WK-5/ WK-6/ WK-7/ WK-8/ WK-2/	**Innovative and Critical Thinking (under relevant courses):** - Complex Problem Solving - Complex Engineering Activities - Semester Project - Case Studies - Open ended labs - Problem Based Learning (PBL)		**Innovative and Critical Thinking (under relevant courses):** - Complex Problem Solving - Complex Engineering Activities - Semester Project - Case Studies - Open ended labs - Problem Based Learning (PBL)	
Total (Engineering domain)		**Min 85**	**Total (Engineering domain)**	**Min 84**
			Flexible Engineering/ Non Engineering Courses) may be adjusted as per the requirements	**8-14**
Total (Credit Hours)		**130 – 136**	**Total (Credit Hours)**	**130 – 136**

Note: * University may offer any course within the specific broader subject domain/ cluster to meet the given credits.
** HEC designed model courses may be used by the university.
*** PEC ECRDC designed courses.