UNIVERSITY OF ENGINEERING & TECHNOLOGY
PESHAWAR

DEPARTMENT OF AGRICULTURAL ENGINEERING

Curriculum of
BSc Agricultural Engineering
"OBE-Based"
(REVISED 2019)

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Program Learning Outcomes (PLO)

Program outcomes (graduate attributes) 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.

No.	PLO	Description
1	Engineering Knowledge	**WA1:** Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization respectively to the solution of complex engineering problems (WK1 to WK4).
2	Problem Analysis	**WA2:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (WK1 to WK4).
3	Design/Development of Solutions	**WA3:** 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 (WK5).
4	Investigation	**WA4:** Conduct investigations of complex problems using research-based knowledge (WK8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
5	Modern Tool Usage	**WA5:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations (WK6).
6	The Engineer and Society	**WA6:** 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 solutions to complex engineering problems (WK7).
7	Environment and Sustainability	**WA7:** Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts (WK7).
8	Ethics	**WA8:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice (WK7).
9	Individual and Teamwork	**WA9:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
10	Communication	**WA10:** Communicate effectively on complex engineering activities with the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
11	Project Management and Finance	**WA11:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work as a member and leader in a team, to manage projects and in multi-disciplinary environments.
12	Life-long Learning	**WA12:** Recognize the need for, and have the preparation and ability to engage in, independent and life-long learning in the broadest context of technological change.

Knowledge Profile (WK)

WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline.
WK2	Conceptually-based mathematics, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline.
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge that supports engineering design in a practice area.
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
WK7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; and the impacts of engineering activity – economic, social, cultural, environmental and sustainability.
WK8	Engagement with selected knowledge in the research literature of the discipline.

University Vision

To be among the top-ranking universities of the world through education, research and innovation.

University Mission

To produce highly qualified, well-rounded professionals through education who play a leading role in the society by powering and driving knowledge-based economy and offer research services and innovation for sustainable development.

Core Values

1. Integrity
2. Teamwork
3. Quality
4. Tolerance
5. Gender equality
6. Social responsibility
7. Collaboration
8. Transparency
9. Professionalism
10. Sustainability

Faculty Mission

To support teachers in providing dynamic leadership for excellent teaching, research, innovation and support to industry thereby, contributing to sustainable socio-economic growth of Pakistan; and to produce well-rounded, enterprising engineering graduates possessed with strong ethical values, professionalism, willingness to work hard and dedicatedly towards improving the world a better place to live for all.

Program Mission

To produce Agricultural Engineers equipped with professional knowledge, skills, and ethical values for effective socio-economical solutions to complex engineering problems.

Program Educational Objectives (PEOs)

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:

1. Be highly competent to establish themselves as practicing professionals in a broad range of career opportunities in public and private sectors at national and international level.

2. Be able to pursue advance studies and seek continuous professional development to remain competitive.

3. Become responsible citizens with high ethical and professional values and be aware of the societal and environmental issues.

Key Performance Indicators (KPI) for Measuring PEO

PEO #	KPI	Measurement Tool
PEO 1	At least 70% graduates would be employed/self-employed	Alumni Survey
	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
PEO 2	At least 30% respondent graduates per academic year would get admission in advanced studies	Alumni Survey
	At least 70% respondent graduates are involved in one or more continuing professional development (CPD) or continuing professional education (CPE) activity as per PEC-CPD laws	
PEO 3	At least 35% of the respondent graduates are involved in activities/projects related to societal, and environmental issues	Alumni Survey

Mapping of PEOs to PLOs

PLO #	PLO	PEO-1	PEO-2	PEO-3
1	Engineering Knowledge	✓	✓	
2	Problem Analysis	✓	✓	
3	Design/Development of Solutions	✓		
4	Investigation	✓		
5	Modern Tool Usage	✓	✓	
6	The Engineer and Society			✓
7	Environment and Sustainability			✓
8	Ethics			✓
9	Individual and Teamwork	✓		
10	Communication	✓		
11	Project Management and Finance	✓		
12	Lifelong Learning		✓	

Course Mapping with Program Learning Outcomes

Course Code	Course Title	Level of Emphasis of PLO (1: High√; 2= Medium; 3=Low)											
		Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Project Management and Finance	Lifelong Learning
		1	2	3	4	5	6	7	8	9	10	11	12
SEMESTER 1													
BSI-101	Islamic Studies						C2		C2				C2
BSI-111	Linear Algebra	C2 C3	C3										
AE-107	Engineering Mechanics	C2	C3										
AE-107L	Engineering Mechanics (Lab)	P2 P3											
AE-104L	Fundamentals of Computer and Applications	C2				P3							
AE-105	Basic Agriculture	C1 C2											
ME-105	Engineering Drawing and Graphics	C1 C3											
ME-105L	Engineering Drawing and Graphics (Lab)	C1								P3			
ME-106L	Engineering Workshops					P3			A1			P3	
SEMESTER 2													
BSI-110	Pakistan Studies						C1 C5 C6						
BSI-122	Calculus	C1	C3										
BSI-142	English Composition and Comprehension										C2 C3		
AE-101	Soil Science	C2 C3											
AE-101L	Soil Science (Lab)								A3	P4	C3		
AE-102	Engineering Materials	C1 C2											
AE-102L	Engineering Materials (Lab)					P3			A3		C3		
AE-106	Mechanics of Materials	C1 C2	C4										
AE-106L	Mechanics of Materials (Lab)								A3	P4	C4		

Course Code	Course Title	Level of Emphasis of PLO (1: High√; 2= Medium; 3=Low)											
		Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Project Management and Finance	Lifelong Learning
		1	2	3	4	5	6	7	8	9	10	11	12
SEMESTER 3													
BSI-231	Differential Equations		C3	C3									
AE-201L	Computer Programming	C2 C3		C3									
AE-203	Soil and Water Conservation Engineering	C1 C2		C3									
AE-203L	Soil and Water Conservation Engineering (Lab)									P3	C3		
AE-204	Fluid Mechanics	C1 C2	C3										
AE-204L	Fluid Mechanics (Lab)			C3		P4				P4			
AE-209L	Computer Aided Design			P4		P3							
CE-226	Surveying-I	C2	C3										
CE-226L	Surveying-I (Lab)								A3	P3	A3		
SEMESTER 4													
BSI-120	Professional Ethics						A1 A2 A3		A1 A2 A3				
BSI-242	Numerical Analysis	C2	C3										
AE-202	Machine Design	C1 C2		C3									
AE-208	Quantity Survey and Cost Estimation	C2 C3											
CE-229	Surveying-II	C2 C3											
CE-229L	Surveying-II (Lab)								A3	P3	C3		
CE-331	Geotechnical Engineering-I	C2	C4		C3								
CE-331L	Geotechnical Engineering-I (Lab)								A3	P3	C4		

Course Code	Course Title	Level of Emphasis of PLO (1: High√; 2= Medium; 3=Low)											
		Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Project Management and Finance	Lifelong Learning
		1	2	3	4	5	6	7	8	9	10	11	12
SEMESTER 5													
BSI-351	Probability and Statistics	C2	C3 C4										
AE-205	Engineering Economics and Management											C1 C2	
AE-206	Agricultural Processing Engineering	C2	C6	C5									
AE-302	Engineering Hydrology	C2 C3	C4										
AE-303	Alternate Energy Resources	C1 C2	C3										
CE-324	Environmental Engineering-I							C2 C3 C5					
SEMESTER 6													
BSI-143	Communication and Presentation Skills										C2 C3		
AE-301	Ground Water Hydrology	C2 C3											
AE-301L	Ground Water Hydrology (Lab)									P4	C4		
AE-305	Farm Irrigation Systems	C2 C5		C4									
AE-306	Farm Machinery and Earth Moving Equipment	C1 C2	C4										
AE-306L	Farm Machinery and Earth Moving Equipment (Lab)									P3 P4	C4		
CE-333	Environmental Engineering-II							C2 C4 C5					
CE-333L	Environmental Engineering-II (Lab)				C4				A3	P3			

Course Code	Course Title	Level of Emphasis of PLO (1: High√; 2= Medium; 3=Low)											
		Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Teamwork	Communication	Project Management and Finance	Lifelong Learning
		1	2	3	4	5	6	7	8	9	10	11	12
SEMESTER 7													
AE-304L	GIS and Remote Sensing	C2				P3							
AE-401	Farm Power	C2 C3	C4										
AE-401L	Farm Power (Lab)									P4	C4		
AE-403	Landscape Engineering	C2	C2	C3									
AE-404	Drainage Engineering	C2		C3									
AE-404L	Drainage Engineering (Lab)					P3					C3		
CE-402	Irrigation Engineering	C1 C2	C3										
AE-411	Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SEMESTER 8													
AE-402	Open Channel Hydraulics	C1 C2		C3									
AE-406	Design of Agricultural Machinery	C1		C3									
AE-407	Farm Structures	C2 C3		C6									
AE-408	On-Farm Water Management	C3		C5									
AE-408L	On-Farm Water Management (Lab)									P4	C5		
AE-409	Environment and Sustainability							C2 C4 C6					
AE-411	Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Curriculum Design

Domain	Knowledge Area*	No. of Courses	Total C.H.	% Overall
Non-Engineering	Humanities	5	12	**27.21**
	Management Sciences	1	3	
	Natural Sciences	7	22	
	Sub Total	**13**	**37**	
Engineering	Computing	4	4	**72.79**
	Engineering Foundation	6	17	
	Major Based Core (Breadth)	13	41	
	Major Based Core (Depth)	10	31	
	Inter-Disciplinary Engineering Breadth	0	0	
	Project	2	6	
	Sub Total	**35**	**99**	
Total		**48**	**136**	**100**

* 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.

Scheme of Studies for B.Sc. Agricultural Engineering Program

Semester 1						
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Knowledge Area**	**Pre-requisite Courses (if any)**	**WK**
1	BSI-101	Islamic Studies	(2-0-2)	Humanities	Nil	7
2	BSI-111	Linear Algebra	(3-0-3)	Natural Sciences	Nil	2
3	AE-104L	Fundamentals of Computer and Applications	(0-1-1)	Computing	Nil	2
4	AE-105	Basic Agriculture	(3-0-3)	Natural Sciences	Nil	1
5	AE-107	Engineering Mechanics	(3-1-4)	Engineering Foundation	Nil	3
6	ME-105	Engineering Drawing and Graphics	(2-1-3)	Engineering Foundation	Nil	3
7	ME-106L	Engineering Workshops	(0-1-1)	Engineering Foundation	Nil	3
		Total	**(13-4-17)**			
Semester 2						
1	BSI-110	Pakistan Studies	(2-0-2)	Humanities	Nil	7
2	BSI-122	Calculus	(3-0-3)	Natural Sciences	Linear Algebra	2
3	BSI-142	English Composition and Comprehension	(3-0-3)	Humanities	Nil	7
4	AE-101	Soil Science	(3-1-4)	Natural Sciences	Nil	1
5	AE-102	Engineering Materials	(2-1-3)	Engineering Foundation	Nil	3
6	AE-106	Mechanics of Materials	(2-1-3)	Engineering Foundation	Engineering Mechanics	4
		Total	**(15-3-18)**			
Semester 3						
1	BSI-231	Differential Equations	(3-0-3)	Natural Sciences	Calculus	2
2	AE-201L	Computer Programming	(0-1-1)	Computing	Fundamentals of Computer and Applications	2
3	AE-203	Soil and Water Conservation Engineering	(3-1-4)	Major Based Core (Breadth)	Nil	4
4	AE-204	Fluid Mechanics	(3-1-4)	Major Based Core (Breadth)	Engineering Mechanics, Calculus	3
5	AE-209L	Computer Aided Design	(0-1-1)	Computing	Engineering Drawing and Design	2
6	CE-226	Surveying-I	(2-1-3)	Major Based Core (Breadth)	Nil	3
		Total	**(11-5-16)**			

Semester 4						
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Knowledge Area**	**Pre-requisite Courses (if any)**	**WK**
1	BSI-120	Professional Ethics	(2-0-2)	Humanities	Nil	7
2	BSI-242	Numerical Analysis	(3-0-3)	Natural Sciences	Nil	2
3	AE-202	Machine Design	(3-0-3)	Major Based Core (Breadth)	Mechanics of Materials	5
4	AE-208	Quantity Survey and Cost Estimation	(2-0-2)	Major Based Core (Breadth)	Engineering Materials	5
5	CE-229	Surveying-II	(3-1-4)	Major Based Core (Breadth)	Surveying-I	3
6	CE-331	Geotechnical Engineering-I	(2-1-3)	Major Based Core (Breadth)	Nil	4
		Total	**(15-2-17)**			
Semester 5						
1	BSI-351	Probability and Statistics	(3-0-3)	Natural Sciences	Calculus	2
2	AE-205	Engineering Economics and Management	(3-0-3)	Management Sciences	Nil	7
3	AE-206	Agricultural Processing Engineering	(3-0-3)	Major Based Core (Breadth)	Fluid Mechanics	4
4	AE-302	Engineering Hydrology	(2-0-2)	Major Based Core (Breadth)	Nil	5
5	AE-303	Alternate Energy Resources	(3-0-3)	Engineering Foundation	Nil	3
6	CE-324	Environmental Engineering-I	(2-0-2)	Major Based Core (Depth)	Nil	4
		Total	**(16-0-16)**			
Semester 6						
1	BSI-143	Communication and Presentation Skills	(3-0-3)	Humanities	English Composition and Comprehension	7
2	AE-301	Ground Water Hydrology	(3-1-4)	Major Based Core (Breadth)	Engineering Hydrology	5
3	AE-305	Farm Irrigation Systems	(3-0-3)	Major Based Core (Breadth)	Basic Agriculture, Soil Science	5
4	AE-306	Farm Machinery and Earth Moving Equipment	(3-1-4)	Major Based Core (Breadth)	Basic Agriculture	6
5	CE-333	Environmental Engineering-II	(2-1-3)	Major Based Core (Depth)	Environmental Engineering-I	4
		Total	**(14-3-17)**			

Semester 7						
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Knowledge Area**	**Pre-requisite Courses (if any)**	**WK**
1	AE-304L	GIS and Remote Sensing	(0-1-4)	Computing	Fundamentals of Computer and Applications	6
2	AE-401	Farm Power	(3-1-4)	Major Based Core (Depth)	Machine Design	5
3	AE-403	Landscape Engineering	(2-0-2)	Major Based Core (Depth)	Surveying-I	5
4	AE-404	Drainage Engineering	(3-1-4)	Major Based Core (Depth)	Nil	5
5	CE-402	Irrigation Engineering	(3-0-3)	Major Based Core (Depth)	Farm Irrigation Systems	5
6	AE-411	Project	(0-3-3)	Project		8
		Total	**(11-6-17)**			
Semester 8						
1	AE-402	Open Channel Hydraulics	(3-0-3)	Major Based Core (Depth)	Fluid Mechanics	5
2	AE-406	Design of Agricultural Machinery	(3-0-3)	Major Based Core (Depth)	Machine Design	5
3	AE-407	Farm Structures	(3-0-3)	Major Based Core (Depth)	Nil	5
4	AE-408	On-Farm Water Management	(3-1-4)	Major Based Core (Depth)	Surveying-I, Fluid Mechanics, Quantity Survey and Cost Estimation	5
5	AE-409	Environment and Sustainability	(2-0-2)	Major Based Core (Breadth)		7
6	AE-411	Project	(0-3-3)	Project		8
		Total	**(14-4-18)**			
		Grand Total	**109-27-136**			

SEMESTER 1

Semester 1						
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Knowledge Area**	**Pre-requisite Courses (if any)**	**WK**
1	BSI-101	Islamic Studies	(2-0-2)	Humanities	Nil	7
2	BSI-111	Linear Algebra	(3-0-3)	Natural Sciences	Nil	2
3	AE-104L	Fundamentals of Computer and Applications	(0-1-1)	Computing	Nil	2
4	AE-105	Basic Agriculture	(3-0-3)	Natural Sciences	Nil	1
5	AE-107	Engineering Mechanics	(3-1-4)	Engineering Foundation	Nil	3
6	ME-105	Engineering Drawing and Graphics	(2-1-3)	Engineering Foundation	Nil	3
7	ME-106L	Engineering Workshops	(0-1-1)	Engineering Foundation	Nil	3
Total			**(13-4-17)**			

BSI-101 ISLAMIC STUDIES

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK7

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	To describe the basic concepts of believes and Arkan-e-Islam, the importance of Quran and Hadith and the concept of Dawah (Tabligh) in Islam.	C2	8, 12
2	To explain the life of the Holy Prophet in Makkah and Madinah (including the basic concepts of jihad & philosophical thoughts of Misaq-e-Madinah, Fath-e-Makkah and Khutbah-e-Hujjatul Widah), and the importance of Honest character.	C2	6, 12
3	To discuss the Islamic civilization and culture, human rights in Islam, the lawful earning and status of family planning in Islamic sharia	C2	6, 8

Basic Concept of Islam, Dawat and Seerat un Nabi, Concept of the Holy War in Islam (Jehad)

Compilation of the Holy Quran, Basic Concepts of Hadith. Hadith as source of Islamic Law

Tafseer Surah Hujuraat and Surah Noor

Islam is a Complete Code of Life

Human Rights in the Light of the Last address of the Last prophet (PBUH) with comparative study with the Human rights granted by UNO

Quran, Science and Technology, Knowledge and Islam

Islamic Civilization

Woman Rights

Lawful earning

Population Dynamics in Islam:

- Family Planning in the Light of Quran and Sunnah
- Analytical Study of the growth of population in the light of Islamic Shariah

Recommended Books:

1. Hassan, M. (2004). *Islamiyat*. Iqra Book Agency Peshawar, Pakistan.

2. Rehmani, K. S. & Masayal, J.F. (2010). *Family Planning in Islam.* Zamzam Publisher Karachi, Pakistan.

3. Tanwi, M. A. A. (2010). *Imdad Ul Fatawa (Family Planning)*. Maktab-E-Darululoom Karachi, Pakistan.

Reference Books:

1. Nadwi, S.A.H. (1985). *A Guide book for Muslims.* Academy of Islamic Research and Publications, Post box No. 119, Nadwatul ulama Lucknow, India. Urdu edition.

2. Dr. Hameed Ullah. *Introduction to Islam.* SH. Muhammad Ashraf publishers, Booksellers and exporters, Lahore, Pakistan.

3. Maulana Manzoor Nomani. *What is Islam.* Published by Allah Bakhsh Barkhurdaria Trust, Karachi, Pakistan

4. Dr. Arif Naseem. *Islamiyat: A standard book for CSS.* Islamia Book Agency Peshawar, Pakistan

5. Muhammad, F.N. (2009). *Islamiyat for students O level*. Published by Ferozsons (Pvt.) Ltd., Lahore, Pakistan.

6. Syed Abul Aala Moudodi. *Deenyat.* Published by Idara e Terjuman Ul Quran, Achrah, Lahore, Pakistan.

BSI-111 LINEAR ALGEBRA

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK2

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	To describe different concepts of linear algebra and optimization	C2	1
2	To apply these concepts for solution of the problems in Sciences and Engineering	C3	1, 2

Solution of System of linear equations and applications. (Gauss Elimination, Gauss-Jordan, Pivoting methods, LU decomposition)

Matrix Algebra, Determinants, Inverse of a matrix, Cramer's Rule

Vectors in R^n, Properties of vectors, application of vectors, vector algebra, inner product

Introduction to vector spaces, Subspaces, linear combination, spanning sets and dependence

Basis and dimension, solution space, null space and rank of a matrix

Eigenvalues and eigenvectors, similar matrices, diagonalization, Application of eigenvalues in dynamical systems

Introduction to linear transformation, Reflection, Rotation, Translation, Basis for range and kernel of a given transformation

Introduction to linear programming, optimization, graphical method, simplex method, optimization problems in engineering and economics

Recommended Books:

1. Kolman, B., & Hill, D.R. (2004). Introductory Linear Algebra: An Applied First Course. 8th Edition, Prentice Hall, USA.

Reference Book:

1. Howard, A., & Rorrers, C. (2011). *Elementary Linear Algebra: Applications Version.* 11th Edition, Kindle Edition, Wiley, USA.

AE-107 ENGINEERING MECHANICS

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Explain the basic concepts and principles of mechanics including statics and dynamics	C2	1
2	Apply and solve the physical laws with logical and mathematical reasoning for different types of problems related to applications in mechanics	C3	2

Introduction to Statics:

Concept of measurement of mass, force, time and space, Systems of units, Fundamentals and Derived units, Conversion of units, required Accuracy of results, General Principles of Statics

Force Systems:

Vector addition, Subtraction and Products, Resultant of Distributed (Linear & Non-linear) force Systems, General conditions of equilibrium of Co-planer forces, Laws of Triangle, Parallelogram and Polygon of forces

Distributed Forces:

Types of beams, Supports and Loads, Simple cases of Axial forces, Shear forces and Bending Moment diagrams

Friction:

Problem involving friction on Flat surfaces

Geometrical Properties of Plane Areas:

Kinetics of Particles:

Work, Energy, Power, Impulse, Momentum, Conservation of Momentum and Energy

Kinematics of Particles:

Rectilinear and Curvilinear motions, Tangential and Normal Components of Acceleration
Simple Harmonic motion:

Recommended Books:

1. Merium, J.L., Kraige, L.G., & Bolton, J.F. (2018). *Engineering Mechanics (Statics).* 9th Edition, Volume-I, Wiley (Wiley Plus Products), USA.

2. Merium, J.L., Kraige, L.G., & Bolton, J.F. (2017). *Engineering Mechanics (Dynamics).* 9th Edition, Volume-II, Wiley (Wiley Plus Products), USA.

AE-107L ENGINEERING MECHANICS (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Show basic knowledge of experimental setup for problems in mechanics.	P2	1
2	Reproduce classroom knowledge and laboratory techniques for demonstration of relevant laws of mechanics in engineering problems.	P3	1

List of Practicals:

1. To find various forces on Roof Truss
2. To find the various forces in various parts of wall crane
3. To Verify the Link Polygon on various forces
4. To Verify the various forces on hanging cord
5. To find coefficient of friction between various materials on inclined plane
6. To verify the Principle of moment in the Disc Apparatus
7. To verify the Principle of moment by bent lever
8. Helical block
9. To draw a Load efficiency curve for a Screw Jack
10. To draw a load efficiency curve for lifting crab
11. To draw a load efficiency curve for wheel and axle
12. To find the moment of inertia by fly wheel
13. To find the moment of inertia by inclined plane
14. To Find friction between Belt and pulley
15. To find the reaction forces on simple supported beam
16. To verify Hook’s law

AE-104L COMPUTER FUNDAMENTALS AND APPLICATIONS (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK2

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Describe computer hardware and software, and their user interface.	C2	1
2	Practice word processing, spreadsheet, and presentation graphics	P3	5

1. Introduction to Computer, History of Computers, Types of Computers
2. To Identify Components of Computer, Hardware, Software and Operating System, User Interface Using Different Input and Output Devices
3. Introduction to Microsoft Word and its Applications Using Different Menus
4. To Prepare an Assignment/Report Title Page in MS Word Including Assignment/Report Title, UET Peshawar Logo, Student Name, Semester, Department and University Name Using Font Type as Times New Roman
5. To Prepare Curriculum Vitae in MS Word (Use Table for Your Academics)
6. To Prepare an MS Word File Containing Main Title and Subtitles, Format it for Creating Updatable Table of Contents, Figures, and Tables.
7. Introduction to Microsoft Excel, Using Basic Calculations/Statistical Functions, Create and Format Different Charts, Preview and Print Worksheets.
8. Introduction to Microsoft PowerPoint and its applications, Create Slides in PowerPoint, Use Design Layouts and Templates, Animation, Slide Transition, Slide Show
9. Basic Skills for an Effective Presentation
10. Students Topics Presentations Related to Computer and Its Applications

Recommended Books:

1. Garry, B.S., & Vermaat, M.E. (2011). *Discovering Computers, Complete: Your Interactive Guide to the Digital World.* 1st Edition, Cengage Learning, USA.

2. Peter, N. (2005). *Introduction to Computers.* 6th Edition, McGraw-Hill/Irwin, New York, USA.
3. Melart, S. (2015). *Microsoft Office 2016: The Complete Guide.* Create Space Independent Publishing, USA.
4. Shelly, G.B., Cashman, T., & Waggoner, G. (1995). *Using Computer, a Gateway to Information*. 2nd Edition, Boyd and Fraser Publishing Company, USA.

AE-105 BASIC AGRICULTURE

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK1

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Understand the basics of agriculture.	C1	1
2	Describe the crop production technology.	C2	1

Introduction

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

Crop Production

History, origin and economic importance, Adaptability to environment, Cultural practices, Cost of cultivation and methods of increasing production, Irrigation Agronomy of Wheat, Maize, Rice, Sugarcane and Cotton. Introduction to Sunflower, Soybean, Canula, Pulses.

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.

Agro-Ecology

Introduction, Weather and Climate, Agro-ecological Features of Pakistan, Agro-ecological zones, Agro-ecology of Khyber Pakhtunkhwa

Recommended Books:

1. Martin, J. D., Leonard, W. H., Stamp, D.L., & Waldren, R.P. (2005). *Principles of Field Crop Production.* 4th Edition, Pearson, UK.

2. Nazir, S. (1994). *Crop Production.* National Book Foundation, Islamabad, Pakistan.

ME-105 ENGINEERING DRAWING AND GRAPHICS

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Define the fundamentals of engineering drawing and graphics.	C1	1
2	Use the fundamental knowledge to sketch different geometrical shapes using projections of lines, planes, and solids.	C3	1

Introduction to Engineering Drawing, Various types of lines, Basic geometrical constructions, Conic sections

Theory of Orthographic Projection

Dimensioning and Lettering

Introduction to Tolerance

Projections of Points

Projections of Straight lines

Projections of Planes and Solids in simple position, Sectioning of Solids

Isometric projections

Development of Surfaces.

Recommended Books:

1. Bhatt, N. D. (2014). *Elementary Engineering Drawing*. 53rd Edition, Charotar Publishing House Pvt. Ltd. India.

2. French, T. E., Vierk, C.J., & Foster, R.J. (1993). *Engineering Drawing and Graphic Technology*. 14th Edition, McGraw Hill Publishing Company, USA.

ME-105L ENGINEERING DRAWING AND GRAPHICS (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Identify engineering drawing tools and principles for making drawings/designs.	C1	1
2	Practice engineering drawings using orthographic projections, sectioning, isometric projections, and 2-D sketches of different mechanical components.	P3	9

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.

Recommended Books:

1. Bhatt, N. D. (2014). *Elementary Engineering Drawing.* 53rd Edition, Charotar Publishing House Pvt. Ltd. India.

2. French, T. E., Vierk, C.J., & Foster, R.J. (1993). *Engineering Drawing and Graphic Technology*. 14th Edition.

3. Parkinson, A. C. (1959). *A First Year Engineering Drawing.* Sir Isaac Pitman & Sons.

ME-106L ENGINEERING WORKSHOPS (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Use proper safety gadgets, safety precautions and other resources including dressing.	A1	8
2	Practice the experimental task and writing skills as per subject requirements.	P3	5
3	Execute the operations involved in different shops.	P3	11

Part – I

Basic Processes in Fitter Shop

Fitting, Sawing, Drilling, Dies and tapping, Reaming, Marking.

Basic Processes in Wood Shop

Timber, its defects and Preservation methods, Different types of wood joints, Brief Introduction to Wood Sawing, Planning, Turning, Mortising processes. Pattern Making, Pattern Types and Allowances.

Basics of Electric Shop

Types and uses of cables, Electric Accessories for House Wiring and testing methods, Types of Wiring Systems, Circuit, Wires specifications.

Function of Forge and Foundry Shop

Brief Introduction, Tools and Accessories, Furnace types, Heat Treatment furnaces. Moulding sands, Mould Making, Casting, Forging Process and Operation.

Machine Shop

Introduction to Machine tools, Basic Lathe operations including Turning, Facing, Screw Cutting, Lathe Parts and Accessories.

Welding

Introduction to Soldering, Brazing and Welding, Brief Details of Gas, and Electric arc Welding, Spot Welding.

Part – II

Students will be assigned Practical jobs in Machine Shop, Electric Shop, Fitting Shop, Carpentry Shop and Smith Shop, Welding and Foundry Shop.

Recommended Books:

1. Chapman, W. A. J. (2016). *Workshop Technology Part 1.* 5th Edition, Routledge, NY, USA.

2. Chapman, W. A. J. (2019). *Workshop Technology Part 2.* 4th Edition, Routledge, NY, USA.

3. Chapman, W. A. J. (2018). *Workshop Technology Part 3.* Kindle Edition, CBS Publishers and Distributors, India.

4. Richter, H. P., & Hartwell, F.P. (2014). *Practical Electrical Wiring: Residential, Farm, Commercial & Industrial.* 22nd Edition, Park Publishing, Inc, USA.

5. Ostwald, P. F. (1997). *Manufacturing Processes.* 9th Edition, John Wiley & Sons, USA.

SEMESTER 2

Semester 2						
1	BSI-110	Pakistan Studies	(2-0-2)	Humanities	Nil	7
2	BSI-122	Calculus	(3-0-3)	Natural Sciences	Linear Algebra	2
3	BSI-142	English Composition and Comprehension	(3-0-3)	Humanities	Nil	7
4	AE-101	Soil Science	(2-1-3)	Natural Sciences	Nil	1
5	AE-102	Engineering Materials	(2-1-3)	Engineering Foundation	Nil	3
6	AE-106	Mechanics of Materials	(2-1-3)	Major Based Core (Breadth)	Engineering Mechanics	4
		Total	**(14-3-17)**			

BSI-110 PAKISTAN STUDIES

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK7

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	To know about Pakistan's historical perspective, geo location, constitutional phases, contemporary affairs, and future challenges	C1	6
2	To summarize major events and lives of prominent personalities related to Pakistan	C5	6
3	To assess national institutions, social issues, Ethincity, Foreign policy and future challenges	C6	6

Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah

Factors leading to Muslim separatism: People and Land, Indus Civilization, Muslim, Location and Geo-Physical features

Government and Politics in Pakistan: Political and constitutional phases: 1947-58, 1958-71, 1971-77, 1977-88, 1988-99, 1999 onward, Contemporary Pakistan

Economic institutions and issues: Society and social structure, Ethnicity, Foreign policy of Pakistan and challenges, Futuristic outlook of Pakistan

Recommended Books:

1. Khan, A. Q. (2006). *Mutala e Pakistan (Urdu).* A. H. Publishers, Lahore, Pakistan.

2. Iqbal, J. (2007). *Pakistan Study.* Islamia Book Agency, Peshawar, Pakistan.

3. Qureshi, I. H. (1969). *The Struggle for Pakistan.* University of Karachi Press, Pakistan.

BSI-122 CALCULUS

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK2

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Know about different types of functions, their graphs, limits, continuities, derivatives and integrations, and to describe the concept of differential calculus	C1	1
2	Apply calculus to the problems involving rate of change, optimization, area under and between the curves, volumes, arc length and area of surface of revolution etc.	C3	2

Mathematical and physical meaning of functions, graphs of various functions, Hyperbolic functions.

Theorems of limits and their applications to functions: Some Useful limits, right hand and left-hand limits

Continuous and discontinuous functions and their applications

Introduction to derivatives: Geometrical and physical meaning of derivatives.

Product Rules, quotient Rules and different rules of derivative, and its applications, problems (rate of change, marginal analysis),

Tangent and normal lines, approximation by Taylor and Maclarun serious.

Maxima and minima, First and Second derivative test.

Integral Calculus, some rules of integrations.

Integration by parts, areas bounded by Curve, Volume of Solid of revolution

Multivariable Calculus, Limit continuity of several variables local curve and local surfaces.

Partial derivatives, Higher order partial derivatives, total differential, tangent plane, normal lines and its applications.

Maxima and minima of two variables.

Vector functions and its derivatives and its integrations, lines integrals, work done and its applications

Gradient, Divergence, Curve and its applications.

Directional derivatives, solenoidal field, equations of continuity, rotational and irrational fields, scalar potential and its applications and fluid dynamics

Method of constraint optimization, Lagrange multiplier method and its applications.

Recommended Books:

1. Thomas, G. B., & Finney, R.L. (2002). *Thomas Calculus.* 9th Edition, Addison Wesley, USA.

2. Dass, H. K., & Verma, R. (2014). *Higher Engineering Mathematics.* 3rd Edition, S. Chand and Company Pvt. Ltd., India.

Reference Books:

1. Croft, A., & Davison, R. (2015). Mathematics for Engineers. 4th Edition, Pearson Education, UK.

2. Smith R. T., Minton, R.B., & Minton, R. (2002). *Multivariate Calculus.* 2nd Edition, McGraw Hill Science/Engineering/Math, USA.

BSI-142 ENGLISH COMPOSTION AND COMPREHENSION

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK7

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Practice English correctly in speaking and writing.	C2	10
2	Apply sound vocabulary and skills to use English in professional life.	C3	10

English Composition

- Words and expressions commonly misused.
- Vocabulary Building skills
- Introduction to parts of speech in detail
- Word formation
- Conditional Sentences & types
- Tense, voice and narration
- Common Grammatical mistakes
- Sentence, its structure, types and kinds
- Paragraph, its structure and types
- Process of writing
- Elementary Principles of Composition and its types
- Relative Pronouns & Clauses

English Comprehension

- **Getting the essential information**
  Finding the main idea
  Defining vocabulary in context

- **Order of importance**
  Using order in the writing to determine what is most important to the author
  Similarities and Differences; using comparisons to determine the author's attitude
  Sentence structure, degree of detail, description and tone.

- **Critical reading and thinking**
  Evaluating evidence and author credibility, rejecting faulty reasoning Reading across the curriculum; asking the right questions to get the most out of reading in the natural sciences, social sciences and Humanities

- **Drawing Conclusions; putting it all together**

Recommended Books:

1. Michael, S. (2017). *Practical English Usage.* 4th Edition: International Edition, Oxford, UK.

Reference Books:

1. Fowler, H. R., Aaron, J.E., & Greer, M. (2018). *The Little Brown Handbook.* 14th Edition, Pearson, UK.

2. Shah, S. A. (2019). *Exploring the World of English.* Ilmi Kitab Khana, Lahore, Pakistan.

AE-101 SOIL SCIENCE

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK1

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Explain the fundamentals of soil and its various properties.	C2	1
2	Determine different soil properties and fertility.	C3	1

The Soil in Perspective

Concept of soil. Edaphological and Pedological approaches of soil. The soil profile and its horizons. Top soil and subsoil. Mineral vs. Organic soils. Major components of Soils. Mineral constituents in soils. Soil organic matter. Soil water. Soil air. Clay and humus. Importance of soil. Soil Degradation and Resilience.

Important Physical Properties of Mineral Soils

Classification of soil particles and mechanical analysis. Soil texture. Nature of soil separates. Soil texture classes. Determination of textural class by the "Feel" method. Laboratory particle-size analyses. Stokes' Law and particle size determined by sedimentation. Soil structure and its types. Structural management of soil. Soil Consistence. Soil density and porosity. Soil Colloids

Soil Water

The importance of soil water. Capillary fundamentals and soil water. Soil water content. Measurement of soil water. Soil water potential and its components. Soil water classification. Flow of water in soil. Water retention. Losses of soil water and their regulation. Consumptive use and efficiency of water use.

Soil Air and Soil Temperature

Soil aeration definition. Soil aeration-The process: Soil aeration in the field, excess moisture, gaseous interchange. Means of characterizing soil aeration: Gaseous composition of the soil air, air-filled porosity. Factors affecting soil aeration. Aeration in relation to soil and crop management. Processes affected by soil temperature: Plant processes, microbial processes, freezing and thawing, permafrost. Absorption and loss of solar energy. Thermal properties of soils. Soil temperature control.

Plant nutrients and fertilizers

Factors controlling the growth of higher plants. Plant nutrients. The essential nutrients from air, water and soil. Role of plant nutrients. Deficiency Symptoms of Nutrients. Fertilizers and soil conditioners. Fertilizer classifications. Fertilizer recommendations for crops. Fertilizer placement. Method of fertilizer application. Management of fertilizers in the soil. Nutrient conversation into fertilizers. Growth regulator

Saline and Sodic Soils

Introduction. Origin of salts. Processes of formation of salt-affected soils. Measuring salinity and sodicity. Classes of salt-affected soils. Reclamation of salt affected soils. Management of reclaimed soils.

Recommended Books:

1. Weil, R. R., & Brady, N.C. (2017). *The Nature and Properties of Soils.* 15th Edition, Macmillan Co. Ltd., USA.

2. Rashid, A., & Memon, K.S. (1996). *Soil Science.* National Book Foundation, Islamabad, Pakistan.

3. Tanji, K. K. (1990). *Agricultural Salinity Assessment and Management.* ASCE No. 71, New York, USA.

AE-101 SOIL SCIENCE (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK1

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Conduct laboratory experiments to determine soil physical and chemical properties	P4	9
2	Adopt necessary protocols by using proper safety gadgets, precautions and instructions	A3	8
3	Prepare lab reports to write procedures and results of experiments.	C3	10

List of Practicals:

1. Study of soil sampling techniques and tools
2. Study of soil profile in field
3. Determination of soil bulk density, particle density and porosity
4. Determination of soil texture
5. Estimation of Soil Moisture by different Methods
6. Determination of soil field capacity
7. Determination of Soil pH and Electrical Conductivity
8. Determination of soil temperature by using soil thermometer
9. Determination of NPK in a soil sample
10. Visits to relevant sites and laboratories

AE-102 ENGINEERING MATERIALS

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Identify basic properties of different engineering materials used for construction.	C1	1
2	Select materials of construction according to various requirements.	C2	1

Stones

Classification and characteristics of good building stones. Tests of stones. Quarrying and dressing of stones. Artificial stones and its varieties, preservation of stone work.

Tiles and Bricks

Different kinds of tiles. Manufacture and uses of tiles. Coloring and glazing of tiles. Fire tiles and bricks. Qualities of good bricks. Refractory bricks and ceramics.

Lime and Cement

Classification of lime. Properties and applications of lime. Types of cement. Manufacturing process of cement. Determination of initial and final setting time. Normal consistency.

Concrete and Mortars

Aggregates for concrete and mortars. Types of concrete. Water cement ratio. Workability of concrete. Compaction and curing of concrete. Types and uses of mortars. Tests for mortars.

Timber

Classification of trees, growth of timber trees. Methods of seasoning and sawing. Decay and preservation of timber, Laminated materials.

Metals

Composition and properties of ferrous and non-ferrous metals. Effect of various heat treatments on the properties of steel and its alloys. Methods of corrosion control.

Paints, Plasters and Varnishes

Composition, preparation, properties, tests and uses of paints, plasters, varnishes and distemper.

Miscellaneous Materials

Composition, varieties, properties and uses of glass, plastics, Laminates and adhesive. Properties and uses of asphalt, rubber and asbestos.

Recommended Books:

1. Allen, E., & Iano, J. (2019). *Fundamental of Building Construction: Materials and Methods.* 7th Edition, Wiley, USA.

2. Smith, W. F. (1995). *Principles of Materials Science and Engineering*. McGraw Hill, USA.

3. Sing, S. (1990). *Engineering Materials.* 5th Edition, Advent Books Division, Revised Edition.

BSI-102L ENGINEERING MATERIALS (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Operate different equipment for testing engineering materials for their properties and strength.	P3	5
2	Adopt necessary protocols by using proper safety gadgets, precautions and instructions.	A3	8
3	Prepare lab reports to write procedures and results of experiments.	C3	10

List of Practicals:

1. Gradation of course aggregates
2. Gradation of fine aggregates
3. Fineness of cement
4. Setting time
   i. Normal consistency
   ii. Initial setting time
   iii. Final setting time
5. Tensile strength of Briquette
6. Compressive strength of mortar cube
7. Soundness test of cement
8. Density of cement and Slump test

AE-106 MECHANICS OF MATERIALS

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK4

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Define types of stress, strain, and mechanical properties of different construction materials.	C1	1
2	Discuss the behavior of structural members subjected to different types of loading and states of stress.	C2	1
3	Analyze the structural members for safety, and apply the basic concepts of fracture mechanism and their limitations for design of structural members.	C4	2

Simple Stresses and Strains

Introduction, types of stresses and strains, elastic limit, modulus of elasticity, yield point, factor of safety, stresses in composite bars and rivet joints, stresses due to change of temperature. Elastic constant: Young's modulus, shear modulus, bulk modulus, Poisson's ratio and relation between elastic constants. Mechanical properties of materials.

Compound Stresses and Strains

Methods for the determination of stresses on oblique sections, use of Mohr's circle to stress problems, and failure theories; moment of inertia; bending stresses in beams, theory of simple bending, bending moments and shear forces in beams, derivation of flexure formula and section modulus. Deflection of beams; area moment method and Castigliano's theorem.

Torsion

Torsion theory for shafts of circular section, power transmitted by shaft, torsion combined with bending. Open and closely coiled helical springs subjected to axial loading. Stresses in thin cylinders and spherical shells

Recommended Books:

1. Hibbeler, R. C. (2016). *Mechanics of Materials.* 10th Edition, Pearson, UK.

2. Beer, F.P., Johnston Jr, E.R., DeWolf, J.T., & Mazurek, D.F. (2014). *Mechanics of Materials.* 7th Edition, McGraw Hill Education, New York, USA.

AE-106L MECHANICS OF MATERIALS (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK4

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Perform laboratory experiments on a beam/bar model to study its behavior under different loading conditions.	P4	9
2	Analyze the experimental data to prepare reports.	C4	10
3	Adopt required protocols in laboratory environment.	A3	8

List of Practicals:

1. Investigation of Hook's law that is the proportional relation between force and stretching and in elastic deformation.
2. Measurement of strains in a Rebar
3. Bend test on a steel bar
4. Determination of Yield/Tensile strength of steel bar
5. Determination of torsion
6. Measurement of forces on supports of statically determinant beams
7. Determination of shear forces in beams
8. Determination of bending moments in beams
9. Measurement of deflection in statically determinant beams
10. Determination of the centroid and moment of inertia of the given structural member

SEMESTER 3

Semester 3						
1	BSI-231	Differential Equations	(3-0-3)	Natural Sciences	Calculus	2
2	AE-201L	Computer Programming	(0-1-1)	Computing	Fundamentals of Computer and Applications	2
3	AE-203	Soil and Water Conservation Engineering	(3-1-4)	Major Based Core (Breadth)	Nil	4
4	AE-204	Fluid Mechanics	(3-1-4)	Engineering Foundation	Engineering Mechanics, Calculus	3
5	AE-209L	Computer Aided Design	(0-1-1)	Computing	Engineering Drawing and Design	2
6	CE-226	Surveying-I	(2-1-3)	Major Based Core (Breadth)	Nil	3
		Total	**(11-5-16)**			

BSI-231 DIFFERENTIAL EQUATIONS

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK2

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	To solve different types of differential equations by understanding fundamental methods and techniques	C3	2
2	To develop force balancing models based on differential equations for different engineering problems	C3	3

PDE, Linear Differential equations, Non-Linear, Differential equations, Solutions of differential equations, General solutions, Particular solutions, Initial and boundary value problems

Separable equations, Homogeneous equations, Differential equations reducible to homogeneous form and related examples

Exact equations, Integrating factors, Linear equations and related examples.

Bernoulli's equations, orthogonal trajectories, Equations solvable for p, Equations solvable for y, Equations solvable for x and related examples

Homogeneous linear equations, Differential operators, Non-homogeneous linear equations, Undetermined coefficients, Cauchy-Euler equations and related examples

Variation of parameters, exact linear equations, linear system of Differential Equations and related examples

Power series solutions of first order Differential Equations, Second order linear equations and related examples

Applications of Ordinary differential equations in Electrical Engineering

Partial Differential Equations: Method of Separation of variables and related examples

Applications of partial differential equations in Engineering

Recommended Books:

1. Kreuzig, E. (2011). *Advanced Engineering Mathematics.* 10th Editions, John Wiley & Sons, USA.

Reference Book:

1. Zill, D. G., & Cullen, M.R. (2008). *Differential Equation with Boundary Value Problems*. 7th Edition, Cengage Learning, USA.

2. Yusuf, S. M., Majeed, A., & Amin, M. (2002). *Mathematical Methods.* 3rd Edition, Ilmi Kitab Khana, Pakistan.

AE-201L COMPUTER PROGRAMMNG (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK2

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Describe the fundamentals of C++ programming	C2	1
2	Write computer programs to solve engineering or mathematical problems	C3	3
3	Implement, debug, and test basic object-oriented programming (OOP) concepts in C++	C3	1

Introduction to programming:

Problem Solving, Algorithms, Flowchart, Programming Languages, Types of codes and language processors, Programming techniques

Introduction to C++ Language:

Program structure,

Data types and declarations, Constants and variables, Statements,

Preprocessor directives

C++ Fundamentals:

Arithmetic operators,

Standard Input/Output, I/O Formatting,

Math Functions,

Structured programming, Type casting

Decision and Iteration Structures:

Conditional expressions, Selection statements, Loop structures

File Input/Output, Procedural programming:

Functions and Recursion:

User-defined functions, Arguments passing among functions, Variable scope, Recursion

Arrays and Matrices:

Problem solving methodology, Pointers:

Introduction to C++, OOP, Classes, Constructor:

OOP, C++ program structure, Classes, Constructor, Objects

Access control to class members, Developing OO application:

Inheritance:

Method overloading & overriding:

Recommended Books:

1. Paul, D., & Deitel, H. (2017). *C++ How to program.* 10th Edition, Pearson, USA.

2. Delores, M. E., & Ingber, J.A. (2016). *Engineering problem solving with C++.* 4th Edition, Pearson, UK.

AE-203 SOIL AND WATER CONSERVATION ENGINEERING

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK4

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Define fundamental terms related to soil and water erosion and conservation.	C1	1
2	Discuss different soil and water conservation methods and structures.	C2	1
3	Apply the learned knowledge to solve problems related to soil and water conservation.	C3	3

Introduction

Importance of soil and water conservation. Historic perspective of erosion, Erosion problems in Pakistan, Erosion agents. Geologic and accelerated erosion. Damages caused by soil erosion.

Wind Erosion

Factors affecting wind erosion. Types of soil movement. Mechanics of wind erosion. Wind erosion control principles. Wind erosion prediction equation.

Water Erosion

Water erosion and its types. Factors affecting water erosion. Sedimentation and pollution in relation to water erosion. Soil Loss estimation models, Erosion control practices.

Rain Water Harvesting

Rainfall intensity and duration. Infiltration, Factors affecting runoff. Damages caused by floods and drought. Importance of Water harvesting, Water harvesting techniques, Runoff vs flood harvesting.

Cropping System and Agronomic Measures for Erosion Control

Planning of Watershed management, Plant cover, Crop rotation, Strip-cropping, Conservation tillage, Contour cultivation, Land capability classification.

Terracing

Field terrace. Classification of terraces. Broad base terraces. Bench terraces. Terrace design. Planning the terrace system. Terrace construction and maintenance.

Vegetated Outlets

Use of vegetated outlets and water courses in the control of erosion. Design of vegetated outlets. Water-way construction and maintenance.

Water Conservation

Why Water Conservation is needed? Water conservation methods, Water storage in soil. Decreasing runoff. Reducing evaporation. Reducing deep percolation. Preventing losses from storage.

Conservation Structures

Earth dam, Check dam, Retaining wall and Spurs. Farm Pond, Hydraulics of Drops Spillways, Chutes and Pipes Spillways; their requirements, components and limitations (applicability)

Recommended Books:

1. Huffman, R.L., Fangmeier, D.D., Elliot, W.J., & Workman, S.R. (2013). Soil and Water Conservation Engineering, 7th Edition, American Society of Agricultural Engineers, USA

2. Frederick, R.T., Hobbs, J.A., & Donahue, R.L. (2004). *Soil and Water Conservation for Productivity and Environmental Protection.* 4th Edition, Pearson Education, Inc., Prentice Hall, New Jersey, USA.

3. Suresh, R. (2000). Soil and Water Conservation Engineering. Standard publishers Distributors, 1705-B Nai Sarak, Delhi, India.

4. Schwab, G.O., Fangmeier, D.D., Elliot, W.J., & Frevert, R.K. (2002). *Soil and Water Conservation Engineering.* 4th Edition, John Wiley and Sons, N.Y. USA.

AE-203L SOIL AND WATER CONSERVATION ENGINEERING (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK4

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Practice the techniques of soil and water conservation.	P3	9
2	Prepare lab reports on soil and water conservation methods.	C3	10

List of Practicals:

1. Measurements of soil loss from water erosion (O.E.L.).
2. Acquisition of data for parameters used in universal soil loss equation.
3. Demonstration of the Soil and Water Conservation Practices and Techniques through models (O.E.L.).
4. Identification of land use capability classes in the field.
5. Collection of sediment samples and determination of different sediment loads.
6. Demonstration of the Soil and Water Conservation Practices and Techniques (including terraces, micro catchments, check dams, ponds etc.) at NARC Islamabad and Fateh Jhang (Attock).

AE-204 FLUID MECHANICS

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Define various basic terms/principles related to fluid mechanics.	C1	1
2	Discuss various parameters/phenomena of fluid mechanics.	C2	1
3	Apply basic concepts of fluid mechanics to real world problems.	C3	2

Introduction

Distinction between a solid and a fluid, gas and fluid, density, specific weight, specific volume, specific gravity, surface tension and compressibility, capillarity, viscosity, units and dimensions.

Fluid Statics

Pressure, Pressure-height relationship, Absolute and Gauge Pressure, Measurement of Pressure, Barometer, Bourden gauge, Piezometer, Manometers, Forces on Submerged Plane and Curved Surfaces.

Equilibrium of Floating Bodies

Buoyancy and Stability of Submerged and floating bodies, Metacentric height.

Fluid Kinematics

Basic concepts about steady and unsteady flow, Laminar and Turbulent flow, Uniform flow and non-uniform flow, Path lines, Stream lines and Stream tubes

Basics of Open Channel and Pipe Hydraulics

Equation of continuity, Energy and Momentum, Uniform and nonuniform flow, Specific energy, Laminar and turbulent, Hydraulic and energy gradients. Losses in pipe lines.

Flow Measurements

Venturimeter, Orifices, Mouthpieces and Nozzles, Pitot tube, Weirs, Notches and Flumes.

Recommended Books:

1. Finnemore, E.J., & Franzini, J.B. (2016). *Fluid Mechanics with Engineering Applications.* 10th Edition, McGraw Hill International, USA.

AE-204L FLUID MECHANICS (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Conduct experiments related to basic fluid mechanics.	P4	5, 9
2	Use the principles and techniques necessary for engineering practices.	C3	3

List of Practicals:

1. Demonstration of various parts of Hydraulic Bench
2. Experimental study of laminar and turbulent Flow
3. Experimental study of tube gauges and Dead weight pressure gauges
4. Calibration of Orifices by Various Methods
5. Calibration of Venturimeter
6. Calibration of Rectangular and Triangular Notch
7. Verification of Bernoulli's theorem
8. Determination of Metacentric Height

AE-209L COMPUTER AIDED DESIGN (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK2

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Practice different engineering designs and drawings on AutoCAD.	P3	5
2	Make drawings of different machine parts and engineering structures.	P4	3

1. Introduction to Computer Aided Design, Graphic Use interface and drawing construction.
2. Interacting with AutoCAD, AutoCAD Commands/Prompt, Transparent Command , Command Aliases
3. World and User Coordinates system, AutoCAD drawing units
4. AutoCAD Drawing commands
5. Edition and Modification of a drawing
6. Basic Utility Commands
7. Dimensioning of a drawing.commands
8. To insert table and text in a AutoCAD
9. Hatch and Gradient Commands
10. Block, Region and Solid Editing
11. To study the properties of solids in AutoCAD
12. Layers in AutoCAD
13. Introduction to AutoCAD 3D and Isometric drawing

Recommended Books:

1. Warren, J.L., & Duff, J.M. (1992). *The Fundamentals of Engineering Drawing: With an Introduction to Interactive Computer Graphics for Design and Production.* 11th Edition, Peachpit Press, San Francisco, USA.

2. Fane, B. (2019). *AutoCAD for Dummies.* 18th Edition, John Wiley and Sons Publications, India.

CE-226 SURVEYING-I

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Describe the techniques, concepts and equipment related to basic land surveying and leveling.	C2	1
2	Apply the basic knowledge of mathematics and surveying in performing the necessary computations in land surveying.	C3	2

Introduction

Introduction to land surveying, Definitions of basic surveying terms branches and their application, Instruments used

Survey Techniques

Distance measurement techniques, Compass survey, and Theodolite survey

Traversing and triangulation

Method of Running Traverses with Theodolite, Traverse computations, Transformation of Co-ordinates, Omitted Measurements, Triangulation, Classification of triangulation systems

Leveling and Contouring

Methods and types of levels, precise leveling, Tacheometry and trigonometrical levelling, Methods and applications of contouring

Computations and Plotting

Maps and plans, plotting, contour maps, profiles, cross-sections, prismoidal formula, Computation of areas and volumes by various methods, Computations of area and volumes by graphical analysis and use of surveying software

Recommended Books:

1. Kanetkar, T.P., & Kulkarni, S.V. (2008). *Surveying and Leveling Part I.* 1st Edition, Pune Vidyarthi Griha Prakashan India.

2. Kanetkar, T.P., & Kulkarni, S.V. (2008). *Surveying and Leveling Part II.* 1st Edition, Pune Vidyarthi Griha Prakashan India.

Reference Books:

1. Kavanagh, B., & Slattery, D.K. (2015). *Surveying with Construction Applications*. 8th Edition, Pearson Education.

2. Wolf, P. R., & Ghilani, C. D. (2004). *Elementary Surveying-An Introduction to Geomatics.* 11th Edition, Prentice Hall, USA.

3. Thomas, M.L., & Ralph, W. K. (2005). *Remote Sensing and Images Interpretation*. 5th Edition, John Wiley & Sons, Inc.

CE-226L SURVEYING-I (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Operate different types of surveying and leveling instruments for field applications.	P3	9
2	Produce plans, profiles, cross-sections using basic surveying techniques and equipment.	C3	10
3	Adopt necessary protocols during experiments needed for safe and disciplined environment.	A3	8

List of Practicals:

1. Introduction to basic surveying instruments
2. Measurement of distances with linear instruments, Chain Surveying and plotting
3. Compass Traversing and plotting
4. Plane Table Surveying by radiation and Intersection methods.
5. Two Points Problem, Three Points Problem
6. Introduction to level and Level adjustments by two-peg method
7. Profile leveling
8. Cross-Sectioning and plotting

Recommended Books:

- Wolf, P.R., & Brinker, R.C. (1997). *Elementary Surveying.* 9th Edition, Kindle Direct Amazon Publishers.
- Kavanagh, B.F. (2005). *Surveying principles and Application*. 7th Edition, Prentice Hall, USA
- Irvine, W.H. (2006). *Surveying for Construction*. 5th Edition, McGraw-Hill

SEMESTER 4

Semester 4						
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Knowledge Area**	**Pre-requisite Courses (if any)**	**WK**
1	BSI-120	Professional Ethics	(2-0-2)	Humanities	Nil	7
2	BSI-242	Numerical Analysis	(3-0-3)	Natural Sciences	Nil	2
3	AE-202	Machine Design	(3-0-3)	Engineering Foundation	Mechanics of Materials	5
4	AE-208	Quantity Survey and Cost Estimation	(2-0-2)	Major Based Core (Breadth)	Nil	5
5	CE-229	Surveying-II	(3-1-4)	Major Based Core (Breadth)	Surveying-I	3
6	CE-331	Geotechnical Engineering-I	(2-1-3)	Major Based Core (Breadth)	Nil	4
Total			**(15-2-17)**			

BSI-120 PROFESSIONAL ETHICS

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK7

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Examine the rational of the diverse definitions of Ethics i.e. theoretical, legal, professional, and personal; also discuss the relative advantages and disadvantages of ethical and unethical conduct	A1	6, 8
2	Identify any religious, National/cultural, International law/doctrine dealing with Engineering Ethics or code of conduct of a professional society	A2	6, 8
3	Identify and debate Ethical case studies dealing with ethical dilemmas ranging from documents to complex engineering projects. Formulate possible solutions and responses to a given ethical dilemma and evaluate the possible consequences of these actions	A3	6, 8

Examine the rational of the diverse definitions of Ethics i.e. theoretical, legal, professional, and personal; also discuss the relative advantages and disadvantages of ethical and unethical conduct

Identify any religious, National/cultural, International law/doctrine dealing with Engineering Ethics or code of conduct of a professional society

Identify and debate Ethical case studies dealing with ethical dilemmas ranging from documents to complex engineering projects. Formulate possible solutions and responses to a given ethical dilemma and evaluate the possible consequences of these actions

Recommended Books:

1. Boatright, J.R. (2005). *Ethics and the Conduct of Business.* Pearson, India.

2. Liley, W. *Introduction to Ethics*.

Reference Books:

1. Winston, M., & Edelbach, R. *Society, Ethics and Technology*.

2. Smith, M.B. *Social Psychology and Human values*.

3. Abbas, K.B. *Contract Ac 1872*.

4. Perry, M.J. *Towards a Theory of Human Rights: Religion, Law, Courts*.

5. Martin, M., & Schinzinger, R. (1996). *Ethics in Engineering*. McGraw Hill, New York.

6. Fledderman, C.D. (1999). *Engineering Ethics*. Prentice Hall, New Mexico.

7. Schlesinger, L. (1996). *How Could You Do That: The Abdication of Character, Courage, and Conscience*. Harper Collins, New York.

8. Carter, S. (1996). *Integrity*. Basic Books, New York.

9. Rusk, T. (1993). *The Power of Ethical Persuasion: From Conflict to Partnership at Work and in Private Life*. Viking, New York.

BSI-242 NUMERICAL ANALYSIS

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK2

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	To describe different numerical techniques in interpolation, differentiation, integration, eigenvalues and solution of algebraic and differential equations	C2	1
2	To apply these techniques for the solution of engineering problems	C3	2

Error analysis, types of error, condition number.
Interpolation: Newton forward and backward difference formula for interpolation, central difference-based interpolation formulae, Lagrange's interpolation polynomial.

Numerical differentiation of first order and higher order and its application in engineering.

Numerical integration (Trapezoidal, Simpson's rules, Boole's rule, Weddle's rule, Romberg integration), Application of integration in Engineering (Area, Volume, Surface area, length of arc etc.)

Numerical method for solution of ODE, Picard's method, Taylor's method, Euler method and its variations. Runge Kutta method, Multi step methods.

Solution of initial and boundary value problem using numerical methods.

Solution of nonlinear equations: graphical method, bracketing methods, iterative methods.

Solution of system equation by numerical methods, Jacobi method, Gauss Seidel method.

Eigenvalues and Eigenvectors: power method, Inverse power method, Shifted inverse power method.

Recommended Books:

1. Richard, L.B., Faires, J.D. & Burden, A.M. (2015). Numerical Analysis. 10th Edition, Cengage Learning, USA.

Reference Book:

1. Hamming, R.W. (2012). Numerical methods for Scientist and Engineers. 2nd Revised Edition, Kindle, Dover Publications, USA.

AE-202 MACHINE DESIGN

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Define the basic nomenclature and fundamentals of mechanical engineering design.	C1	1
2	Discuss the construction and working of different machine elements.	C2	1
3	Apply the standard procedures and techniques to design different machine elements.	C3	3

Introduction

Meaning of Mechanical Engineering Design, Phases of design, Design considerations, Safety and product reliability, Codes and standards, evaluation and presentation

Design of Simple Machine Components:

Design of shafts, torsion of circular shafts, horsepower transmitted by the shafts, design of clutches, bearings, gears, flange couplings, pulleys and connecting rod

Design of Fasteners and Connections

Different types of fasteners. Thread standards and definitions, Mechanics of power screws. Bolts strength and selection of units, Bolt preload, torque requirement, Bolted, riveted and welded joints loaded in shear, Keys pins, and retainers

Elements of Rotary Power Transmission

Belts, Stresses in belts, Chain and sprocket drives, Gears drives, Flexible shafts, Bearings

Recommended Books:

1. Budynas, R., & Nisbett, K. (2019). *Mechanical Engineering Design.* 11th Edition, McGraw Hill Education, USA.
2. Spott, M.F., Shoup, T.E., & Hornberger, L.E. (2004). *Design of Machine Elements*. 8th Edition, Pearson Prentice Hall, Upper Saddle River, NJ, USA.
3. Shigley, J.E., & C. R. Mischhe, (2000). *Mechanical Engineering Design*. 5th Edition. McGraw Hill Publications Inc. USA

AE-208 QUANTITY SURVEY AND COST ESTIMATION

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Describe different types of estimation (quantity/cost) used in engineering projects/activities.	C2	1
2	Apply different estimation methods to prepare bill of quantities and cost estimates of engineering projects/activities.	C3	1
3	Discuss elements of tenders, contracts, and bids.	C2	1

Introduction:

Introduction to engineering works; Basic Terminologies; General practice in government departments for schedule of rates and specifications; Specifications for various items of construction.

Cost Estimation and Pricing:

Importance of estimates; rates and cost analysis of construction materials; Types of estimates and their detailed description; Valuation, depreciation and sinking funds; estimation of the cost and rent of a building; 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, canal structures, water management and conservation structures.

Quantity Take-off and Measurement:

Discuss Quantity take-off and measurement; Measurement of masonry, wood, glass and wall finishes; Earthwork calculations; Contents and preparation of bills of quantities for different projects like irrigation, water management and conservation structures, sanitary, canal structures, building etc.; Maintaining the measurement books.

Tenders and Contracts:

Types of Contracts; Obligations of Employer and the contractor; Preparation of engineering contracts and tender documents; Claims and conflicts resolution; Evaluation of proposals and contracts.

Recommended Books:

1. Lee, S., Trench, W., & Willis, A. (2014). *Willis's Elements of Quantity Surveying.* 12th Edition, Wiley Blackwell Publishers, New Jersey.
2. Dutta, B.N. (2017). *Estimating and Costing in Civil Engineering.* 22nd Edition, UBS Publishers Distributors, India.

CE-229 SURVEYING-II

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Describe the modern techniques, concepts and equipment's related to different type of survey.	C2	1
2	Apply the knowledge of surveying and mathematics related to setting out of highway and railway curves.	C3	1
3	Apply the knowledge of surveying and mathematics related to the hydrographic surveys, field astronomy, GPS survey, photogrammetry and tunnel surveys.	C3	1

Highway and Railway Curves

Circular curves, deflections and chord calculations, Setting out circular curves by various methods, Compound curves, reverse, vertical, parabolic curves, Computation of high or low point on a vertical curve, Design considerations, spiral curves, spiral curve computations, Approximate solution for spiral problems, super elevations

Construction Surveys

Introduction, horizontal and vertical control, Buildings, rail roads, Route surveys, Pipeline and other construction surveys

Control Surveys

Geodesy universal transverse Mercator grid system, Modified transverse Mercator grid system, Lambert projection, Computations for lambert projection

Hydrographic Surveys

Objectives of hydrographic survey and electronic charting, Vertical control, depth and tidal measurements, Position fixing techniques, Sounding plan, horizontal control

Field Astronomy

Solar and stellar observations for position and azimuth determination

Photogrammetry

Introduction, Application of aerial and terrestrial photogrammetry, Stereoscopy

Tunnel Surveying

Introduction, Surface Alignment, Setting out from Ends, Transferring Alignment Underground, Use of gyroscope

Recommended Books:

1. Kanetkar, T.P., & Kulkarni, S.V. (2008). *Surveying and Leveling Part II.* 1st Edition, Pune Vidyarthi Griha Prakashan India.

Reference Books:

1. Wolf, P. R., & Ghilani, C. D. (2004). *Elementary Surveying – An introduction to Geomatics.* 11th Edition, Prentice Hall, USA.

2. Thomas, M. L., & Kiefer, R.W. (2005). *Remote Sensing and Images Interpretation.* 5th Edition, John Wiley & Sons, Inc.

3. Barry, K., & Slattery, D.K. (2015). *Surveying with Construction Applications*. 8th Edition, Pearsons Education.

CE-229L SURVEYING-II (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Adopt necessary protocols during experiments needed for safe and disciplined environment.	A3	8
2	Perform the experiments for measuring the quantities related to theodolite traversing, contouring and setting out of different types of curves.	P3	9
3	Produce maps and plans by plotting data related to experiments discussed in CLO-2.	C3	10

List of Practicals:

1. Study and Use of advanced surveying equipment, Theodolite Traversing, Contouring
2. Simple Curve. Compound Curve, Transition Curve, Operation of Total Station, Operation of GPS.
3. Advance surveying instruments
4. Theodolite instruments
5. Setting out a Simple curve
6. Setting out a Compound curve
7. Setting out a Transition curve
8. Total station
9. EDM
10. GPS

Recommended Books:

1. Wolf, P.R., & Brinker, R.C. (1997). *Elementary Surveying.* 9th Edition, Kindle Direct Amazon Publishers.
2. Kavanagh, B.F. (2005). *Surveying Principles and Application*. 7th Edition, Pearson Education, USA.

3. Irvine, W. (2006). *Surveying for Construction.* 5th Edition. McGraw Hill, National Library of Australia.
4. Davis, R.E., & Foote, F.S. (1956). *Surveying Theory and Practice*, 4th Edition, McGraw Hill Book Company, Inc. New York

CE-331 GEO-TECHNICAL ENGINEERING-I

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Explain fundamental engineering concepts of soil's behavior on basis of its physical properties, index properties and modes of formation.	C2	1
2	Apply the basic geotechnical properties to classify soil by various classification systems.	C3	4
3	Analyze effects of compaction, seepage and vertical stresses on engineering behavior of soil.	C4	2

The Nature of Soils

Introduction to Geotechnical Engineering and Soil Mechanics, Importance, Formation of Soil, Transportation, sorting, deposition, Soil types, Soil fabrics, Clay minerals, surface forces and absorbed water

Index and Physical Properties of Soil

Particle size distribution: Sieve Analysis, Hydormeter Analysis, phase relationships, Examples relative density, physical states and index properties of fine-grained soils

Soil Classification Schemes

Unified Soil Classification System, AASHTO Soil Classification System

Seepage

Soil water, Capillarity, Seepage and Darcy's Law, Determination of coefficient of permeability measurements-lab and field, Capillarity, Seepage theory, flow nets Solved Examples

Soil Compaction

Moisture density relationship basic concept, Standard and modified Proctor Tests, interpretation of proctor test results, benefits of soil compaction, field compaction,

compaction quality control (Sand Cone Test (ASTM D 1556), Balloon Test (ASTM D 2167), Nuclear Density Meter (ASTM D 2922, ASTM D 5195)

Stresses in Soil

Stresses from elastic theory, Point load, line load, strip area carrying uniform pressure, Solved Examples, strip area carrying linearly increasing pressure, Circular area carrying uniform pressure, Solved Examples, Rectangular area carrying uniform pressure, Influence Chart for vertical stress, Examples

Soil Investigation

Importance of S.I, purpose of SI, phases of SI, soil exploration program, soils explorations methods: Geophysical Methods (GPR, Seismic Surveys, Electrical Resistivity, others), Trial pits, hand or power augers, wash boring, rotary rigs, percussion rigs, Soil identification in the field, Number and depths of borings, Soil sampling, Ground water conditions, Soil lab tests, Type of field or in-situ tests (VST, SPT, CPT, PMT, DMT).

Recommended Books:

1. Knappet, J., & Craig, R. F. (2019). *Soil Mechanics*. 9th Edition, CRC Edition, Taylor and Francis Group.

2. Budhu, M. (2010). *Soil Mechanics and Foundations*. 3rd Edition, John Wiley and Sons, Canada.

CE-331L GEO-TECHNICAL ENGINEERING-I (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Perform the experiments related to basic engineering properties and characteristics of soil.	P3	9
2	Analyze the experimental data and prepare a technical lab report	C4	10
3	Adopt necessary protocols during experiments needed for safe and disciplined lab environment.	A3	8

List of Practicals:

1. Identification of Soil (Visual Manual Procedure)
2. Determination of Moisture content of soil
3. Determination of specific gravity of soil
4. Determination of liquid limit of soil
5. Grain-size analysis of soil (including both mechanical and hydrometer analysis) Determination of Plastic limit and Plasticity Index of soil
6. Determination of shrinkage limit of soil
7. Classification of soil according to AASHTO and USCS
8. Modified/Proctor Compaction Test
9. Constant Head Permeability test (Granular Soil)
10. Falling Head Permeability (Granular and Fine-grained soils)
11. Chemical Analysis of soil

Recommended Books:

1. Atkinson, J. (1993). *An Introduction to Mechanics of Soils and Foundation*. McGraw Hill College.
2. Knappet, J., & Craig, R. F. (2019). *Soil Mechanics.* 9th Edition, CRC Edition, Taylor and Francis Group.
3. Das, B.M. (2006). *Principles of Geotechnical Engineering*. 6th Edition, Nelson, a Division of Thomson Canada Ltd.

SEMESTER 5

Semester 5						
1	BSI-351	Probability and Statistics	(3-0-3)	Natural Sciences	Calculus	2
2	AE-206	Agricultural Processing Engineering	(3-0-3)	Major Based Core (Breadth)	Fluid Mechanics	4
3	AE-205	Engineering Economics and Management	(3-0-3)	Management Sciences	Nil	7
4	AE-302	Engineering Hydrology	(2-0-2)	Major Based Core (Breadth)	Nil	4
5	AE-303	Alternate Energy Resources	(3-0-3)	Engineering Foundation	Nil	4
6	CE-324	Environmental Engineering-I	(2-0-2)	Major Based Core (Depth)	Nil	4
Total			**(16-0-16)**			

BSI-351 PROBABILITY AND STATISTICS

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK2

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	To acquire the basic concept of statistics and probability and their need in engineering	C2	1
2	To apply the rules of probability and statistics to understand different engineering problems	C3	2
3	To analyze various engineering problems through probabilistic techniques	C4	2

Basic Statistics:

Statistics, Branches of Statistics, Importance of statistics, population, sample, observation, variables, measurement of variable, Data, primary data, secondary data

Data Presentation:

Frequency distribution (grouped, ungrouped), stem and leaf display histogram, frequency polygon, cumulative frequency polygon

Measure of Central Tendency:

Introduction and computation of measure of central tendency by five methods (A.M, G.M, H.M, Median, Mode), applications, Merits, Demerits,

Measure of Dispersion:

Introduction and computation of measure of dispersion by five methods (Range, Quartile deviation, Mean deviation, Variance, Standard deviation), Types, Application, Merits, Demerits

Moments:

Measure of Skewness, Measure of Kurtosis, Central moment, Raw moments, Moments ratio

Simple Regression and Correlation:

Introduction to regression theory, Simple linear regression line, Line fitting by least square methods, Coefficient of determination, Simple correlation, types, correlation coefficient of correlation

Probability, Laws of Probability:

Experiments, Random experiments, Sample Space, Events, Types of Events, Counting rules(Multiplication, Permutation, Combination), Definition of probability(classical, empirical, axiomatic approach), Laws of probability(complementation, addition, conditional, multiplication, Bayes), independent, dependent events

Random Variable:

Random Variable, types (Discrete Random Variable, Continuous Random Variable), Probability functions, probability density functions, distribution function, probability distribution, Joint probability distribution, mathematical expectation, Measure of central tendency and dispersion of random variables. Covariance and correlation b/w two random variables

Discrete Probability Distribution:

(Binomial, Hypergeometric, Poisson, Negative binomial, geometric) distribution, properties of the above distribution

Continuous Probability Distribution:

Normal distribution, exponential distribution, properties

Statistical Inference:

Introduction to inferential statistics, branches (Estimation, hypothesis testing of population mean, proportion)

Recommended Books:

1. Chuadary, S.M. *Introduction to statistical theory part 1*. (Latest Edition)

2. Kreyszig, E. *Advanced Engineering Mathematics.* (Latest Edition)

Reference Books:

1. Ronald E. Walpole, Raymond H, Myers and Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, Prentice Hall Decoursey W., Statistics and Probability for Engineering Applications, Newness

2. Soong, T. F. *Fundamentals of Probability and Statistics for Engineers*. John Wiley and Sons

AE-205 ENGINEERING ECONOMICS AND MANAGEMENT

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK7

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Define the basic terms in project management, engineering economics, and project scheduling and analysis method.	C1	11
2	Explain the cost effectiveness of individual engineering projects using the methods learned and draw inferences for the investment decisions.	C2	11

Engineering Economics:

Engineering Economics, Principle of Engineering Economics, Time Value of Money, Interest Rate, Cash Flow Diagrams, Inflation and Deflation, Present; Future; and Annual Worth Analysis, Rate of Return, Benefit-Cost Analysis, Simulation and Optimization (Linear Programming; i. Graphical method, ii. Simplex method).
Assets, Liabilities, Capital and Revenue Expenditure, Depreciation, Depletion, Amortization, Owner's Equity Debentures, Loan Financing, Accounting, Qaurds, Ledgers, Profit and loss statement.

Management Fundamentals

Management, Administration, Leadership, Relationship Vs Task Management, Project and Program, Project Management VS General Management, Project Life Cycle, Trade Off.
Project Manager, Special Demands on the Project Manager, Selection of a Project Manager, Role and Responsibilities, Career Path, Common Characteristics of a most effective Team.
Line/Project Organization, Functional Organization, Matrix and Mixed Organization.

Project Budgeting, Scheduling and Control

Budgeting Methods, Cost Estimation, Budget Uncertainty and Risk Management.
Network Techniques, PERT, CPM & GRANT Charts, Use of Project management Softwares, Crashing of a Project, Physical Assets Control, Human Resource Control, Financial Control.

Marketing Management

Selling versus Marketing, Role of a company: Leader, Follower, Challenger, Basics of Marketing, Place, Price and Promotion. Role of a company in Market Place.

ISO 9000 and Quality Management

ISO 9000: International Quality Management, Quality Management in Pakistan, Fundamental Quality Concepts, Quality Terminology, Importance and Benefits of ISO-9000, Common Misunderstanding about ISO-9000, Classification of ISO-9000 Series, Brief Description of 20 Elements of ISO-9000, the Auditing Process.

Procurement Management:

Procurement Management, Procurement Categories, Procurement Constraints/Risks, Selection of Contract Types, Six Components of a Procurement Management (Procurement Process, Roles and Responsibilities, Identified Procurement Needs, Timing, Change Review and Approval Process, Vendor Processes).

Recommended Books:

1. Leland, B., & Tarquin, A. (2011). *Engineering Economy.* 7th Edition, McGraw Hill Education, USA.

2. Chang, C. M. (2016). *Engineering Management: Meeting the Global Challenges*. 2nd Edition, CRC Press, USA.

3. Meredith, J. R., & Mantel, S.J. (2000). *Project Management.* McGraw Hill Pub. Company, USA.

4. Fleming, Q. W. (2016). *Project Procurement Management.* FMC Press, California, USA.

AE-206 AGRICULTURAL PROCESSING ENGINEERING

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK4

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Define basic concepts of agricultural processing and explain different unit operations in agricultural processing.	C2	1
2	Select the most suitable equipment for processing operations.	C5	3
3	Evaluate the cost of different agricultural processing operations.	C6	2

Pumps for Processing Operations

Centrifugal pumps, Characteristics Curves, Centrifugal pump laws, Pump performance on a system.

Fans for Processing Operations

Classification of fans and types, Fan theory, Factors affecting fan selection, General performance of fans.

Size Reduction

Size characteristics, Tyler sieves, Fineness modulus, Size reduction procedures, Reducing devices, Performance characteristics.

Cleaning and Sorting

Functions of cleaning, Grade factors, cleaning methods, Sorting fruits and vegetable, Cleaning and sorting grain, nuts and seeds.

Material Handling

Belt Conveyors, Chain conveyors, Screw conveyors, Bucket elevators, Gravity conveyors, lift and carrying trucks and carts.

Heat Transfer

Conduction, Study state conduction through composite walls, Convection, Radiation, Heat exchanger.

Drying

Importance of drying, moisture content determination, methods of drying, drying procedures.

Refrigeration

Natural refrigeration. Mechanical refrigeration, refrigeration cycle, Qualities of refrigerants. Components of refrigeration system, Heat pumps.

Cost Analysis

Items of cost, Calculation of depreciation, life expected, interest on investment, Housing, other factors.

Recommended Books:

1. Sahay, K. M., & Singh, K.K. (2004). *Unit Operations of Agricultural Processing.* 2nd Revised Edition, Vikas Publication House Pvt. Ltd. India.

2. Henderson, S. M., & Perry, K.L. (1976). *Agricultural Process Engineering.* 3rd Edition, AVI Publication comp Westport, Connecticut. Marks Handbook McGraw Hill Co.

AE-302 ENGINEERING HYDROLOGY

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK4

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Explain hydrological cycle and its different components.	C2	1
2	Apply the knowledge of hydrological principles for estimating water balance.	C3	1
3	Analyze various hydrological components using appropriate hydrological techniques.	C4	2

Introduction

Hydrology, Scope of Hydrology, Hydraulics and Hydrology, Hydrologic cycle, Hydrologic equation.

Meteorology

Introduction, Atmosphere, meteorological observations and instruments

Precipitation

Factors affecting precipitation, Classification of precipitation, Measurement of Precipitation, Analysis of Precipitation data, Areal Precipitation, Seasonal variation, Major storm studies and Snow melt.

Runoff

Base flow and surface runoff, Factors affecting runoff. Estimation of runoff. Rational Method

Stream Gauging

Stage-Gauge, Selection of gauge site, Measurement of stage, Current meter, Method of discharge measurement, Common errors in discharge measurements, Stage discharge rating curves.

Hydrograph Analysis

Hydrograph, Time of concentration, Components of hydrographs, Separation of Hydrograph Components, Factors affecting Hydrograph shape, Unit Hydrograph, The S-Curve.

Recommended Books:

1. Shaw, E. M. (1994). *Hydrology in Practice.* 3rd edition. Chapman & Hall, London.

2. Awan, N. M. (1981). *Surface Water Hydrology*. Vol. I & II: 1st Ed., National Book Foundation, Islamabad, Pakistan.

AE-303 ALTERNATE ENERGY RESOURCES

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK3

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Identify main sources and types of renewable and non-renewable energies and their relative contribution to the global and national energy budget.	C1	1
2	Explain various energy resources and their impact on the society and environment.	C2	1
3	Estimate power from different energy sources using systematic engineering approach.	C3	2

Introduction:

Overview of various types of energy sources (renewable and Non-renewable) and its use in the country.

Energy reclamation from agricultural crops/wastes (Biopower):

Energy from biomass production. Biogas, various types of biogas plants. Design, installation, operation and management of biogas plants.

Solar Energy:

Solar system, solar radiation, basic earth-sun angles, time derived solar angles, estimation of solar radiation, radiation measurements, solar radiation collectors, various uses of solar energy in domestic/agriculture, solar energy conservation

Wind energy:

Wind energy potential in the country. Application of wind energy (domestic / agriculture). Importance of vertical and horizontal axis for windmills, wind operated pumps for water lifting.

Geothermal Energy:

Basic concepts, Heat transfer, Geothermal systems and resources, Exploration techniques.

Hydropower:

Principles, Assessing the resource from small installations, Measurement of head, Measurement of flow rate, Turbines, Hydroelectric systems.

Recommended Books:

1. Smith, Z.A., & Taylor, K.D. (2008). *Renewable and Alternative Energy Resources. A Reference Handbook.* Santa Barbara, California Denver, Colorado Oxford, UK.
2. Fornasiero, P., & Graziani, M. (2016). *Renewable Resources and Renewable Energy-A Global Challenge*. 2nd Edition. CRC Press Taylor & Francis Group, New York, USA
3. Efstathios, E.M. (2012). *Alternative Energy Sources.* Department of Engineering, Springer, Texas, USA.
4. Sorensen, B. (2004). *Renewable Energy.* Elsevier Academic Press, UK.
5. Tiwari, G.N., & Mishra, R.K. (2012). *Advanced Renewable Energy Sources.* Centre for Energy Studies, Indian Institute of Technology Delhi, New Delhi, India.
6. Twidell, J., & Weir, T. (2006). *Renewable Energy Resources*. 2nd Edition, Taylor & Francis, New York, USA.
7. Efstathios, E.M. (2018). *Energy, the Environment, and Sustainability*. 1st Edition, CRC Press Taylor & Francis Group, New York, USA.

CE-324 ENVIRONMENTAL ENGINEERING-I

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK4

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Explain key current environmental problems and identify the effect of the pollutants on the environment; different types of water distribution; water quality and treatment methods.	C2	7
2	Apply knowledge of environmental engineering in water distribution and treatment.	C3	7
3	Design water supply schemes, and treatment plants	C5	7

Introduction to Environmental Engineering:

History, Background and some basic definitions.

Water Quantity:

Population Forecast, Water Uses & Consumption, Types and Variation in Demand, Maximum demand & Fire Demand, Rural Water Supply, Appropriate Technology

Water Quality:

Water impurities and their health significance, Water Quality Standards (U.S & WHO etc), Water Quality Monitoring

Water Distribution:

Layout and Design of Water Transmission works and Distribution networks, Service Reservoirs, Fixtures and their installation, Tapping of Water mains

Water Treatment:

Treatment of Surface and Ground Water, Screening, Sedimentation, Coagulation, Coagulants & dosages, Filtration, design Aspects of Slow Sand & Rapid Sand Filters, Filtration Rates, Operation Head Loss, Back wash and Filter Efficiency, Pressure Filters, Fluoridation, Hardness Removal, Iron & Manganese removal, Water Softening Methods, Water

Disinfection & Chemicals, Use of Chlorine, Quantity, Dosage and Efficiency, Dosage & Efficiency Treatment Methods

Water Sampling and Testing:

Sampling Techniques & Examination of Water (Physical, Chemical & Microbiological Parameters), Diseases, Waterborne, Food borne, Milk borne and Vector borne Diseases

Pollutants:

Effects and Control of Environmental Pollution, Toxic/Hazardous Waste Introduction to relevant Software Packages

Recommended Books:

1. Mackenzie, L. D., & Cornwell, D.A. (1998). *Introduction to Environmental Engineering.* 3rd Edition 1998, McGraw Hill, New York, USA.

2. Terence, J., & McGhee. (1991). *Water Supply & Sewerage.* 6th Edition, McGraw Hill, USA.

SEMESTER 6

Semester 6						
1	BSI-143	Communication and Presentation Skills	(3-0-3)	Humanities	English Composition and Comprehension	7
2	AE-301	Ground Water Hydrology	(3-1-4)	Major Based Core (Breadth)	Engineering Hydrology	5
3	AE-305	Farm Irrigation Systems	(3-0-3)	Major Based Core (Breadth)	Basic Agriculture, Soil Science	5
4	AE-306	Farm Machinery and Earth Moving Equipment	(3-1-4)	Major Based Core (Breadth)	Basic Agriculture	6
5	CE-333	Environmental Engineering-II	(2-1-3)	Major Based Core (Depth)	Environmental Engineering-I	5
Total			**(14-3-17)**			

BSI-143 COMMUNICATION AND PRESENTATION SKILLS

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK7

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Prepare official letters, memorandums and reports, and also be able to produce these documents in a professional manner	C2	10
2	Participate in communicative activities based on the learned rules	C3	10

The Nature of Communication:

Process of communication, Communication in an organization, Basic Principles of Effective Communication, Importance and Components of Communication

Meetings:

Various Kinds of Meetings, Purposes of Meetings, Leadership Responsibilities in Meetings

Key Points to Remember While Writing a Resume:

Various Formats of Resume Writing, Why Include a Cover Letter, Writing a Cover Letter
Writing Business Letter, Minutes and Memorandums

Communication through Debate

How to Express Effectively During Debate, Better public speaking and presentation

Interview and its types

The Rules of Interview Taking, What Makes an Interview Successful
The Significance of Technology in Communication, Power Point Presentations

Speaking in Public Places:

Strategies for improving oral delivery, Phonetic symbols and rules of pronunciation

Long (Formal Reports):

Prefatory Sections, Supplemental Sections, Presentations of Long Reports

Persuasive Written Messages and Presentations, Persuasive speaking:

Writing and Presenting Proposals:

Kinds of Proposals, Parts of Proposals

Team Communication:

Listening:

Process and kinds of listening, TOEFL and IELTS Practice Tests

Negotiation Skills:

Recommended Books:

1. Murphy, H.A., Hildebrandt, H.W., & Thomas, J.P. *Effective Business Communication.*

Reference books:

1. Fry (OUP), C. *Summary Writing (Book-I)*. Latest edition
2. Rogerson, P., & Gilbert, J.B. *Speaking Clearly*. Latest edition
3. Weisman, H.M. *Basic Technical Writing*. Latest edition
4. English Course by Linguaphone Institute, London. Latest edition
5. Thomson, A.J. & Martinet, A.V. *Practical English Grammar-Exercises 01*. 3rd Edition, Oxford University Press.

AE-301 GROUND WATER HYDROLOGY

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Explain the fundamentals of subsurface water and aquifers.	C2	1
2	Apply the principles of groundwater hydraulics to confined and unconfined aquifers.	C3	1
3	Explain the methods of well development.	C2	1

Introduction

Basic concepts of ground water and soil water, Forms and origins of ground water, Types of subsurface water, Aquifer types, Aquifer functions: Porosity; Storage coefficient; Hydraulic conductivity; transmissivity, Water Potential

Ground Water Movement

Darcy's Law and its applications, Observation wells, Peizometers, Flow nets, Streamlines, Equipotential lines, Steady and non-steady flow.

Well Hydraulics

Steady flow in confined and un-confined aquifers, Steady flow in confined and unconfined aquifers with uniform recharge, Unsteady flow in confined and unconfined aquifers, Wells near aquifer boundaries, Multiple well system, Specific capacity, Well losses, Well efficiency and aquifer testing.

Wells

Test holes and Well logs, Methods for constructing wells, Methods for drilling wells, Well development, Design of wells and gravel packing, Tube well performance tests.

Recommended Books:

1. Johnson. (1988). *Ground Water & Wells.* Johnson and Co. USA.

2. Ranghunath, H.M. (1987). *Ground Water*. Willy Eastern Ltd. Singapore.

3. Bouwer, H. (1996). *Ground water Hydrology*. McGraw Hill Inc. New York.

4. Ahmad, N. (1985). *Ground water Resources of Pakistan*. Shahzad Nazir Publisher, Gulberg-III, Lahore.

AE-301L GROUND WATER HYDROLOGY (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Demonstrate the determination of aquifer properties using laboratory equipment.	P4	9
2	Prepare lab reports to analyze and interpret results of experiments.	C4	10

List of Practicals:

1. Determination of water level by various techniques.
2. Determination of Hydraulic Conductivity of an aquifer
3. Determination of Specific yield of an aquifer material
4. Verification of Darcy's law using Ground water Flow/Well Abstraction Rig
5. Demonstration of drawdown curve of a single well through unconfined aquifer
6. Demonstration of drawdown curve of multiple wells and application of principal of superposition
7. Determination of Ground water flow rates and direction
8. Determination of Well losses and Well efficiency
9. Determination of Aquifer characteristics
10. Evaluation of an available Ground water Computer Model

AE-305 FARM IRRIGATION SYSTEMS

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Explain fundamentals of farm irrigation systems and their limitations	C2	1
2	Design different farm irrigation systems	C5	1
3	Select the most suitable farm irrigation system for desired irrigation water depth	C4	3

Farm Irrigation Systems and Systems Design Fundamentals

Functions of farm irrigation systems, Types of farm irrigation systems such as diversion methods, conveyance methods, and application methods, Design of farm irrigation systems, Data for design, Water source evaluation and determination of daily design requirements.

Crop Water Requirements

Plant soil relationship, Evapotranspiration, Determination of evapotranspiration and irrigation scheduling.

Surface Irrigation

Different methods of surface irrigation, furrow irrigation, border irrigation and basin irrigation, Surface irrigation process, Effectiveness of surface irrigation i.e. uniformity, application efficiency etc. Design of surface irrigation system, Infiltration data for surface irrigation, Design of furrow, border and basin irrigation systems.

Sprinkle Irrigation System

Advantages and disadvantages of the system, Types of sprinkle system, Components of sprinkle system, Design of set-move including its layout, number of lateral operated per irrigation set and sprinkle selection.

Trickle Irrigation

Advantages and disadvantages of trickle irrigation, Problems associated with trickle irrigation, Trickle irrigation methods, Trickle irrigation system components, Trickle irrigation laterals, Mainlines and manifolds, Control heads and control of trickle irrigation clogging.

Recommended Books:

1. Jensen, M.E., & Allen, R.G. (2016). *Evaporation, Evapotranspiration, and Irrigation Water Requirements.* 2nd Edition. American Society of Civil Engineers Press, USA.
2. Hoffman, G.J., Evans, R.G., Jensen, M.E., Martin, D.L., & Elliott, R.L. (2007). *Design and Operation of Farm Irrigation Systems.* 2nd Edition, American Society of Agricultural and Biological Engineers, USA.
3. James, L.G. (1993). *Principles of Farm Irrigation System Design*. Krieger Publication Corporation, New York, USA.

AE-306 FARM MACHINERY AND EARTH MOVING EQUIPMENT

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK6

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Define basic terms/principles related to agricultural machines.	C1	1
2	Discuss elements of farm machinery and farm mechanization.	C2	1
3	Analyze performance and operation and perform cost analysis of different farming activities involving machines/implements.	C4	2

Field Capacities and Cost Analysis

Implements Types, Factors affecting field capacity, Cost analysis

Hydraulics Controls and Power Take Off (PTO) Drives

Components of a hydraulic system, Types of hydraulic system, Single, Parallel & Series cylinder systems, Limit control, Automatic position and Draft control, Hydrostatic Propulsion drives, PTO drives using two universal joints, Three-joints PTO drives, Loads imposed on P.T.O. shafts, Recommended PTO load limits.

Tillage Force Analysis and Hitching

Forces acting upon a tillage implement, Mechanics of tillage, Tillage tool design factors, Measuring & evaluating performance, Measuring draft of implements, Vertical and horizontal hitching of trailed implement, Hitches for mounted implements, Depth and draft control on hitches.

Tillage Implements

a) Primary tillage implements

Function & Types of Mold board plows, Components of a mold board plow, Reaction of soils to mold boards, Pulverizing action, Turning & inversion, Scouring, Forces acting upon a plow bottom, Effects of soil types, depth of plowing shape & design, attachments & rear

furrow wheel and speed on draft & performance. Functions, components & types of Disk plows, Rotary plows, Chisel & subsurface plows.

b) Secondary tillage implements

Functions, components & types of Harrows, Cultivators. Land rollers and Pulverizers, Subsurface tillage tools & field cultivators.

Equipment for Sowing and Planting

Functions, components & types of planting equipments, Seed metering devices, Maize drills, Calibration of seed drill. Broadcasting machines, Fertilizer and insecticide placement. Transplanting machines, Spraying systems.

Grain and Seed Harvesting

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

Earth Moving Equipment

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

Recommended Books:

1. Kepner, R. A., Bainer, R., & Barger, E.L. (2018). *Principles of Farm Machinery*. Kindle Edition. CBS Publishers and Distributors Pvt. Ltd.

2. Smith, H. P. (2020). *Farm Machinery and Equipment*. Kindle Edition. Morse Press, USA.

AE-306L FARM MACHINERY AND EARTH MOVING EQUIPMENT (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK6

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Demonstrate the construction and working of different farm implement and machinery.	P4	9
2	Perform evaluation of different farming activities involving farm implements and machines.	P3	9
3	Prepare lab reports to analyze and interpret experimental data.	C4	10

List of Practicals:

1. Identification of Primary Tillage Implements.
2. Identification of Secondary Tillage Implements.
3. Determination of Field Capacity of Agricultural Field Implements under actual field condition.
4. Determination of Field Efficiency of Agricultural Field Implements.
5. Determination of tractor Wheel Slip.
6. Calibration of grain drills in Laboratory.
7. Calibration of grain drills in Field.
8. Study and operation of Tractor Hydraulic System.
9. Mini Project (O.E.L).

CE-333 ENVIRONMENRAL ENGINEERING-II

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK4

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Discuss Wastewater Quality Standards, Wastewater Pollution, Sanitary Fixtures and sewer appurtenances, Sewage and Solid waste characteristics, Integrated solid waste management.	C2	7
2	Outline different types of Wastewater collection systems, Wastewater treatment techniques.	C4	7
3	Design sewerage (sanitary and storm) systems and wastewater treatment plants, Requirements and arrangements of building drainage.	C5	7

Introduction:

History, Background and some basic definitions.

Environmental Legislation and Regulation:

Failure of International treaties, the “Dutch Green Plan”.

Estimation of Sewage Quantities:

Types, Shapes, Size and materials of Sewers, Pipe Strengths and Tests. Rainfall runoff estimation Sanitary sewage quantities, variations and rates of Flows, Velocity gradient & limiting velocities.

Sampling and Testing Techniques:

Sampling techniques and Examination of wastewater (Physical, Chemical and Microbiological Parameters), Design, construction and maintenance of sewage system, Sewer appurtenances,

Environmental Impact Assessment:

Steps and development of report, Examples from Pakistan and Finland, Hurdles and problems in Pakistan

Municipal and Industrial Wastes, water Pollution, Causes and Control Parameter, Pakistan National Environmental Quality Standards (NEQS), Effluent disposal guidelines and Standards hydraulic, chemical and biological loading rates required for design of wastewater treatment system.

Sewage Treatment and Disposal:

Preliminary, primary, secondary treatment of wastewater, Grit Chamber example. Construction and Maintenance of Sewer System and Analysis, diameter and Gradient, Sewer joints, Grading, Laying, Jointing and Testing of Sewers.

Solid Waste Management:

Types, characteristics, sources and quantities of solid waste; Collection disposal and recycling.

Recommended Books:

1. Tchobanoglous, G., Burton, F.L., & Stensel, H.D. (2017). *Wastewater Engineering: Treatment and Reuse.* 4th Edition, McGraw Hill.

2. Kiely, G. (1997). *Environmental Engineering.* International Edition, McGraw Hill.

CE-333L ENVIRONMENRAL ENGINEERING-II (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	01
Total	=	01	Total	=	45

Knowledge Profile = WK4

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Perform the experiments related to analysis of basic parameters of water and wastewater.	P3	9
2	Analyze the experimental data and prepare a technical Lab report with regard to the health significance of the society.	C4	4
3	Adopt necessary protocols during experiments needed for safe and disciplined Lab environment.	A3	8

Practicals:

1. Introduction to environmental laboratory
2. Sampling techniques, samples collection, storage and transport
3. Measurement of Turbidity
4. Determination of Total Dissolved Solids (TDS) in water and wastewater
5. Determination of Total Alkalinity in water and wastewater
6. Determination of Chlorides in water and wastewater
7. Determination of Sulphides in water and wastewater
8. Determination of B.O.D in water and wastewater
9. Determination of C.O.D in water and wastewater

SEMESTER 7

Semester 7						
S. No.	**Course Code**	**Course Title**	**Credit Hours**	**Knowledge Area**	**Pre-requisite Courses (if any)**	**WK**
1	AE-304L	GIS and Remote Sensing	(0-1-4)	Computing	Fundamentals of Computer and Applications	6
2	AE-401	Farm Power	(3-1-4)	Major Based Core (Depth)	Machine Design	5
3	AE-403	Landscape Engineering	(2-0-2)	Major Based Core (Depth)	Surveying-I	5
4	AE-404	Drainage Engineering	(3-1-4)	Major Based Core (Depth)	Nil	5
5	CE-402	Irrigation Engineering	(3-0-3)	Major Based Core (Depth)	Farm Irrigation Systems	5
6	AE-411	Project	(0-3-3)	Project		8
Total			**(11-6-17)**			

AE-304L GIS AND REMOTE SENSING (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK6

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Explain basic knowledge related to GIS and RS.	C2	1
2	Practice GIS software for different types of map making.	P3	5

Displaying Data

Creating map, Adding tabular data to a map, Symbolizing data. Labeling, Charting and Map projection. Layout.

Querying Data

Getting attributes of features, Attribute of particular feature, Feature near other, Fall inside polygon, Intersect other feature. Aggregation of data.

Data Creation

Creating and editing spatial data. Registration and digitization. Working with images and aerial photographs. Working with CAD in GIS environment.

Analyzing Data for Specific Purposes

Creating suitability map for various purposes. Soil, rainfall and water pollution map for various parameters. Use of GRID data for groundwater sources.

Creation of Surface Model

Creating 3D shapes. Advanced visualization. Representing surfaces with TINs. Creation of TINs. Creation of Slope and Aspect theme. Making contours lines. Analyzing surface runoff patterns. Measuring areas and volumes.

Remote Sensing

Remote Sensing and Historical overview: from maps to digital earth; Electromagnetic energy, sources, EM spectrum and wavelength ranges, Optical Remote Sensing, Microwave Remote

Sensing, Multispectral Remote Sensing. Geometric Correction, Supervised /Unsupervised Classification, Accuracy Assessment.

Recommended Books:

1. Lee, J., & Wong, D.W.S. (2002). *Statistical Analysis with Arc View GIS*. John Wiley and Sons, Inc. New York.

2. Andy, M. (2001). *ESRI guide to GIS Analysis*. ESRI Press, Red Lands.

3. Liu, J.G., & Mason, P.J. (2016). *Image processing and GIS for remote sensing: techniques and applications*. Wiley Blackwell.

4. Congalton, R.G., & Green, K. (2009). *Assessing the Accuracy of Remotely Sensed Data: Principles and Practices*. 2nd Edition, CRC Press.

5. Reddy, M.N. (2008). *Remote Sensing and Geographic Information System.* BS Publications, 3rd Edition, Hyderabad - 500 095 - A.P. India.

Recommended Softwares and GPS

1. Arc View 3.x, ArcGIS 10.x, MapInfo

2. SNAP (Sentinel Application Platform) Software

AE-401 FARM POWER

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Describe tractor power and its measurement and explain different processes and systems of tractors	C2	1
2	Determine different parameters related to engine construction and working processes of tractor	C3	1
3	Analyze stability of tractor under loaded/unloaded conditions	C4	2

Introduction to Farm Power and Measurement of Tractor's Power

Introduction to farm power and its types, Power Adjectives (Indicated; Brake/Belt; Friction and Drawbar power), Brake, Drawbar and Torsion dynamometers, Strain gauges

Thermodynamic Principles of Internal Combustion Engine

Boyle's law, Charles law, Energy equation, Constant volume changes, Constant pressure changes, Isothermal changes, Adiabatic changes, Polytropic changes, Air standard Otto and Diesel cycles, Real cycles

Valve and Valve Timing

Valve function, Valve types, Design of valves, Firing orders of four- and six-cylinder engines, Valve timing

Fuel Testing

Introduction and classification of fuels, Knocking and Detonation, Octane and Cetane numbers, Controlling knocking

Carburetion and Fuel Induction

Fuel-Air ratio requirements, Fuel and Air Flow in a carburetor, Simple carburetor, Starting, idling and compensation, Carburetor adjustments, Intake Manifolds

Ignition Systems

Ignition systems and types, Operation, maintenance and repair principles of battery, Ignition switch, Ignition coil, Breaker points, Condenser, Distributor, Spark plugs, Electric starter, Magneto ignition system

Diesel Engine

Principles of Compression-ignition (CI) engine operation, Fuel injection systems for single unit and multiple unit injection, Fuel filters, Diesel engine starting methods

Engine Cooling and Cooling System

Cooling load, Heat transfer, Air and water cooling systems, Construction of radiators, Fans, pumps, Antifreeze materials or Coolants, Corrosion inhibitors

Lubrication and Lubrication System

Lubrication and Sources of Lubricants, Lubrication systems of engines, Types and properties of lubricating oils, Oil additives, Greases, Oil filters

Engine Accessories

Governor and its types, Principles of centrifugal governor, Spark arresters, Mufflers, Air inlet location and Pre-cleaners, Oil bath and Dry type air cleaners

Transmission Systems

Transmission systems, Differentials, Brakes and Clutches, Power take-off, Pulley drives, Power lift and hydraulic controls

Mechanics of the Farm Tractor Chassis

Force Analysis, Soil reaction, Drawbar pull and Weight transfer, Stability of tractors, Tipping and Lateral stability, Center of gravity of tractor and its determination

Recommended Books:

1. Heywood, J. B. (2018). *Internal Combustion Engine Fundamentals*. 2nd Edition, McGraw-Hill Education.

2. Gupta, H. N. (2013). *Fundamentals of Internal Combustion Engines*. 2nd Edition, Prentice-Hall of India Pvt. Ltd.

3. Goering, C. E., and Hansen, A. C. (2004). *Engine and Tractor Power*. 4th edition, ASAE. © American Society of Agricultural Engineers (Rev. Sept. 2005)

AE-401L FARM POWER (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Demonstrate the construction and working of different systems and components of a tractor	P4	9
2	Operate hydraulic dynamometer for measuring tractor power	P4	9
3	Prepare lab reports to analyze and workout the results of dynamometer tests	C4	10

List of Practicals:

1. To study the construction and parts of four-stroke, spark-ignition engine model.
2. To determine the brake power, PTO power, and fuel efficiency of a diesel tractor at different speeds by means of hydraulic dynamometer.
3. To study the working and construction of carburetor model.
4. To study the battery-ignition system of a tractor.
5. To study the inline fuel injection pump model of a diesel tractor.
6. To study the cooling system of a tractor.
7. To study the transmission system and differential of a tractor model.
8. To study the different types of clutch and brake of a tractor.
9. To study the working and parts of turbocharger.
10. To study the operation of automatic hydraulic clutch.

AE-403 LANDSCAPE ENGINEERING

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Discuss the elements and principles of Landscape Designs.	C2	1
2	Describe different types of Landscape Designs and Buildings.	C2	2
3	Compute the cost of a landscape design.	C3	3

Introduction

Introduction to Landscape Engineering, Importance of landscaping, Principles and elements of landscape design.

Designing of Landscape

Landscape design process, factors affecting the designing phase, preparation of plans and schemes, making the bubble diagram of the base map, planting plans, plants suitable for various designs, landscape design materials, hardscape and structural elements of a landscape like patios, decks and paths, etc.

Landscape Design Styles

Types of designs; formal and informal garden designs, Chinese and Japanese gardening, gardens with special features, recreational areas, highways and roadside plantations

Landscape Buildings

Introduction to historic landscape and its types, landscape designs for public and private buildings, discussing some landscapes of Pakistan

Developmental Cost Estimates for Landscape

Making an estimation sheet and BoQ for a landscape project.

Mini project (C.E.P.)

Recommended Books:

1. Booth, N.K., & Hiss, J.E. (2017). *Residential Landscape Architecture: Design Process for The Private Residence*. 7th Edition, Pearson Publishers.
2. Arora, J.S. (2007). *Introductory Ornamental Horticulture*. 6th Edition, Kalyani Publishers, New Delhi.
3. Ingels, J., & Smith, A.F. (2018). *Landscaping Principles and Practices.* 8th Edition, Cengage Learning, USA.
4. Khan, M.A., & Bader, T.A. (1992). *Landscape Designs.* Student Manual. University Printing Press, University of Agriculture, Faisalabad.

AE-404 DRAINAGE ENGINEERING

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Discuss different types of drainage systems and identify the situations that necessitate drainage of agricultural lands.	C2	1
2	Design the surface and sub-surface drainage systems.	C3	3

Basics of Agricultural Drainage

Introduction to land drainage: Definition and objectives of drainage, Drainage problems in Pakistan. Land drainage systems: Sources of excess water, Design considerations for land drainage, Types of drainage systems.

Drainage Investigations and Planning

Reconnaissance survey. Preliminary survey. Design survey. Investigations for surface and subsurface drainage systems. Drainage coefficient and its determination. Field methods for measuring hydraulic conductivity. Planning an effective drainage system.

Design of Surface Drainage Systems

Introduction. Components of surface drainage system. Design consideration for field drains and field laterals. Layout and design of field drains and laterals. Design of open ditches for drainage.

Design of Subsurface Drainage Systems

Purpose and benefits of subsurface drainage. Types of subsurface drainage systems. Layout of pipe drainage systems. Steady state flow to drains. Hooghoudt's equation derivation. Design of subsurface drains: relief drains, interception drains and mole drains. Installation and construction of subsurface drains. Filters and Envelopes. Economic aspects of drainage.

Pump Drainage and Biodrainage Systems

Scope. Surface drainage pumping conditions. Subsurface drainage pumping conditions. Location of the Pumping Plant. Classes of pumped wells. Basis for design of pumped-

drainage wells. Pumping plant capacity. Advantages of pumped-well drainage, Conjunctive use of fresh and saline water. Economic justification of pumping plant. Biodrainage System

Operation and Maintenance of Drainage System

Operation of drainage systems. Maintenance of buried pipe drainage system, open drainage system, drainage water disposal ponds and drainage observation well. Policy and basic requirements. Weed control and embankment stability.

Recommended Books

1. Vlotman, W.F., D.W. Rycroft & L.K. Smedema (2020). Modern Land Drainage: Planning, Design and Management of Agricultural Drainage Systems. 2nd Edition.

2. Jha, M.K & K. Yellareddy (2020). Drainage Engineering. <www.agrimoon.com>

3. USDA Soil Conservation Service (SCS). Drainage of Agricultural Land. National Engineering Handbook; Section 16. Engineering Division, 1971; Washington, D. C. 20250. (Latest edition).

4. Drainage Manual (1978): A water resources technical publication: A guide to integrating plant, soil, and water relationships for drainage of irrigated lands United States Bureau of Reclamation/USBR, United States Department of the Interior/USDI, Washington D.C.

AE-404L DRAINAGE ENGINEERING (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Operate the equipment to carry out required experiments.	P3	5
2	Prepare lab reports to communicate the results of experiments.	C3	10

List of Practicals:

1. Determination of crop water requirements, irrigation schedules and scheme water supply using CROPWAT.
2. Estimating discharge in drainage channel
3. Measurement of Canal Seepage Loss by inflow-outflow method
4. Measurement of Canal Seepage Loss by Ponding Method
5. Design of a drainage ditch
6. Design of drain spacing using Hooghoudt's method
7. Determining in-situ saturated hydraulic conductivity of soil
8. Computation of leaching requirement and drainage coefficient of a drainage basin.
9. Determination of EC and pH of irrigation water
10. Field visits of waterlogged areas and projects

CE-402 IRRIGATION ENGINEERING

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Define basics of irrigation and water resources.	C1	1
2	Discuss different methods and processes involves in irrigation engineering.	C2	1
3	Apply knowledge of irrigation engineering to solve basic and complex issues.	C3	2

Introduction to Water Resources of Pakistan

Irrigation

Methods of irrigation, Irrigation water requirement and its measurements. Irrigation water quality, Irrigation systems i.e. Furrow, Border, Sprinkler and Trickle

Diversion Headworks

Canal headworks, selection of their site and layout, weirs and barrages. Various components/structures used in headworks and their functions. Measures adopted to control silt entry into canals, silt ejectors and excluders.

Canals

Design of irrigation canals including Kennedy's and Lacey's designs, Canal lining - advantages and types, maintenance of irrigation canals.

Irrigation Works

Introduction to Canal head regulators, falls, flumes, canal outlets, cross drainage works - types and functions, Monitoring of flows - telemetry system.

Water logging and salinity

Causes and effects of water logging and salinity with special reference to Pakistan, reclamation methods, Drainage network in irrigated areas.

Dams

Types of dams, crest width, forces on dams, criteria for site selection and type of dams. Reservoirs, sedimentation and delta formation, freeboard (fetch, wave run up and set up), Introduction to Environmental impacts of Dams.

Field Visit or Project Brief

Site visit to water resources infrastructure or brief introduction to a real time project

Recommended Books:

1. Garg, S.K. (2006). Irrigation Engineering & Hydraulic Structures. 19th Edition, Khanna Publishers, India.

2. Novak, P., Moffat, A.I.B., Nalluri, C. & Narayanan, V. (2007). Hydraulic Structures. 4th Edition, Taylor & Francis.

AE-411 PROJECT

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	03	Lab	=	135
Total	=	03	Total	=	135

Knowledge Profile = WK8

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.

SEMESTER 8

Semester 8						
1	AE-402	Open Channel Hydraulics	(3-0-3)	Major Based Core (Depth)	Fluid Mechanics	5
2	AE-406	Design of Agricultural Machinery	(3-0-3)	Major Based Core (Depth)	Machine Design	5
3	AE-407	Farm Structures	(3-0-3)	Major Based Core (Depth)	Nil	5
4	AE-408	On-Farm Water Management	(3-1-4)	Major Based Core (Depth)	Surveying-I, Fluid Mechanics, Quantity Survey and Cost Estimation	5
5	AE-409	Environment and Sustainability	(2-0-2)	Major Based Core (Breadth)		7
6	AE-411	Project	(0-3-3)	Project		8
		Total	**12-4-16**			

AE-402 OPEN CHANNEL HYDRAULICS

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Define different terminologies relevant to open channel hydraulics	C1	1
2	Explain the fundamental principles governing open channel hydraulics	C2	1
3	Apply knowledge of hydraulics for the hydraulic design of open channel	C3	3

Basic Concepts of Fluid Flow

Types, state and regimes of flow, channel flow types, channel geometry, measurement of velocity in channel, velocity distribution in channel and its coefficients, pressure distribution in channel, effect of slope on pressure distribution.

Energy and Momentum Principle

Basic equations, Specific energy, Specific energy and alternate depths, E-Y relationship, Criteria for a critical state of flow, computation of critical flow, control of flow, application of flow control in rectangular channel, momentum in open channel flow, specific momentum, hydraulic jump, M-Y relationship.

Uniform Flow

Establishment of uniform flow, The Chezy's and Manning's equations, resistance coefficient estimation, normal depth and velocity, normal and critical slopes, free board, best hydraulic section, determination of section dimensions.

Rapidly Varied Flow

Characteristics of varied flow, sharp crested weir, aeration of the nappe crest shape and discharge over spillway, type and characteristics of the jump, jump as energy dissipater, flow through sudden transitions.

Recommended Books:

1. Chow, V.T. (2009). *Open Channel Hydraulics.* Illustrated Edition. The Blackburn Press; Illustrated Edition.

2. French, R. H. (1996). *Open Channel Hydraulics.* McGraw Hill International Book Company.

3. Henderson, F.M. (1990). *Open Channel Flow*. McMillan Publishing Co.

AE-406 DESIGN OF AGRICULTURAL MACHINERY

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Explain various concepts for designing and development of different parts of agricultural machinery.	C1	1
2	Apply various concepts for designing and development for different part of agricultural machinery.	C3	3

Philosophy of Design

Formulating of procedure, importance of machine design in Agricultural Machinery, Reliability, Engineering Standards, User economics.

Statistics Tolerance Design

Tolerance and allowances, application of statistics to manufacturing.

Stresses

Stress failure theory, Designing 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.

Recommended Books:

1. Chen, G. (2018). Advances in Agricultural Machinery and Technologies. 1st Ed. Published by CRC Press, Taylor and Francis Group, USA.

2. Budynas, R. G. and J. K. Nisbett (2015). Mechanical Engineering Design. 10th Edition. Published by McGraw Hill Education, NY, USA.

3. Krutz, G., L. Thompson, and P. Claar (1984). *Design of Agricultural Machinery.* John Wiley and Sons Inc. USA.

AE-407 FARM STRUCTURES

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Explain the fundamentals of farm buildings.	C2	1
2	Determine the heating, cooling and ventilation requirements of the farm buildings.	C3	1
3	Design different facilities of farm structures.	C6	3

Heat flow through Walls Insulation:

Rate of heat transmission through building materials, conductance, combined conductance coefficient, Equation for heat flow through non-homogenous walls, combined ceiling and roof coefficient.

Ventilation:

Air flow and quantity of moisture, Air flow required in heat transfer, Estimating Air flow required to prevent condensation, Air flow required to maintain prescribed chemical composition, Heat balance equation, Exposure ratio, Ventilating systems, Ventilation by Wind forces, Stack ventilation Systems, Construction practices, Forced draft systems.

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.

Poultry Housing:

Functional planning, Production practices, Environment, Space requirements, Arrangement or space, Insulation and ventilation, other considerations.

Storage of Fruits and Vegetable Crops:

Condition for storage, Refrigerated vs Common Storage, Economic aspects of storage, Characteristics of Common storage, Refrigerated storage, Refrigerating Load, Modified Atmosphere Storage, Types of Evaporators, Coil Temperature vs Relative Humidity and Equipment capacity, Air movement, Storage management.

Storage of Grains:

Destructive agents, Respiration of grains, Indices of quality, Moisture and Temperature changes in stored grains, Moisture properties of grains, Functional requirements, Conditioning moist grains, Storage structure, Equipment for grain handling and processing.

Recommended Books:

1. Barre, H.J., & Sommet, L.L. (1963). *Farm Structure.* John Wiley and Sons. Inc, New York, USA
2. Cleghorne, W.S.H. (2017). *Farm Buildings and Building Construction in South Africa; a Textbook for Farmers.* Agricultural Students, Teachers, Builders, etc. Andesite Press, USA
3. Hopkins, A. (2011). *Modern Farm Buildings: Being Suggestions for the most approved ways of designing the cow barn, dairy, horse barn, hay barn, sheepcote, piggery, house, and other buildings of the farm group.* Spellman Press, USA.
4. Barnes, A.M., & Mander, C. (2000). *Farm Building Construction*. Farming Press, UK.

AE-408 ON-FARM WATER MANAGEMENT

Credit Hours			**Contact Hours**		
Theory	=	03	Theory	=	03
Lab	=	0	Lab	=	0
Total	=	03	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Design and develop structures/strategies for management, harvesting, and conservation of water in irrigated and rainfed regions.	C5	3
2	Apply agronomic principles and practices for crop, land, soil and water management.	C3	1

Water Course Design and Improvement

Introduction, Planning for watercourse improvement Design criteria, Hydraulics of watercourse design, Different cross-sections of watercourse, Watercourse design, Materials and procedures, Moghas, Construction of unlined and lined watercourses, cross drainage and control structures (aqueduct, siphon, super passage, culvert, check/turnout).

Water Management through Precision Land Leveling

Precision land leveling, Goal and objectives, Advantages and disadvantages of land leveling, Farm assessment and layout, Layout and survey for Ordinary and Laser leveling, Adjustments for borrow and fill, Procedure for sloping fields, Land leveling maintenance.

Water Storage Tanks

Sizing a water storage tanks, General criteria, Design criteria, Construction of water storage tank, Preparatory works, Materials and procedures, Concrete base, Brick or stone walls, Concrete walls, Back filling. Stone pitching.

Water Harvesting

Introduction, Goal and objectives, Site selection, Topographical surveys, Land use plan, Land development and conservation structures; leveling, terracing, improved bunds, improved tillage, field spillways, waterways, diversion ditches, Storage structures; water balance, site investigation, water retention dams/ponds.

Agronomy Practices for Water Management

Development of Crops and Cropping Systems, Principles of Crop Management, Management of land and Soil, Seed and Sowing, Fertilizers and Nutrients, Crop protection, Harvest and Post-harvest Technology, Objectives, selection and conduction of Farm Demonstration Centers.

Conjunctive Use of Water

Conjunctive use of saline groundwater. Effects of sediment and salinity on conjunctive use of water.

Recommended Books:

1. Ali, M. H. (2010). *Fundamentals of Irrigation and On-farm Water Management: Volume 1*. Springer.

2. Ali, M. H. (2011). *Practices of Irrigation and On-farm Water Management: Volume 2*. Springer.

3. On Farm Water Management Field Manuals, (Revised 1996-97)
   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
   Ministry of Food, Agriculture and Livestock (Federal Water Management cell) Government of Pakistan, Islamabad.

4. Hoffman, G. J., Howell, T.A., & Solomon, K.H. (1992). *Management of Farm Irrigation Systems (ASAE Monograph).* 2nd Printing, ASAE.

AE-408L ON-FARM WATER MANAGEMENT (LAB)

Credit Hours			**Contact Hours**		
Theory	=	0	Theory	=	0
Lab	=	01	Lab	=	03
Total	=	01	Total	=	45

Knowledge Profile = WK5

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Conduct different engineering surveys for designing water management and harvesting structures/strategies at the farm level.	P4	9
2	Prepare lab reports/design sheets/quantity and cost estimates for watercourse construction; precision land leveling; and water storage tanks.	C5	10

List of Practicals:

1. Study instruments/equipment used in surveying and leveling of different water management activities.
2. Measurement of discharge/flow using different instruments and techniques.
3. Profile survey of a watercourse.
4. Design, quantity and cost estimation of a watercourse using computer software.
5. Making layout of a field and survey for precision land leveling.
6. Design, quantity and cost estimation of a water storage tank using computer software.
7. Development of land-use map for a water harvesting site (O.E.L.).
8. Development of cropping plan for different AERs based on four Fs (O.E.L.).
9. Practical demonstration of water management, conservation and harvesting structures.

AE-409 ENVIRONMENT AND SUSTAINABILITY

Credit Hours			**Contact Hours**		
Theory	=	02	Theory	=	02
Lab	=	0	Lab	=	0
Total	=	02	Total	=	30

Knowledge Profile = WK7

Course Learning Outcomes (CLO)

CLO#	CLO	Taxonomy	PLO
1	Explain the human-environment interaction and its significance at local, regional, and global scale.	C2	7
2	Analyze the environmental, social, and economic dimensions of sustainability.	C4	7
3	Develop capacity for integrative thinking and practice.	C6	7

Introduction

Basic Concepts of Human and Environment Interaction and its Associated Problems, Different Approaches to the Environment and Sustainable Development.

Climate Change & Sustainable Development

Concept of Climate Change, Contemporary Climate Change Debates, Pakistan's Climate Change Policy, Linkages and Issues

Water, Environment and Sustainable Likelihood

Water Challenges of Pakistan, National Water Policy, Water Governance, Sustainable Likelihood Framework and its Applications, Approaches and Assessment of Water Policy

Technology and Contemporary Challenges

Technology and Environment Interaction, Techniques for Nature Sustainable Conservation and Control

Institution and Environmental Governance

The concept of Institutional Work & Environmental Governance, Institutional Limits and Innovative Reforms, Individual/Organizational Use of Natural Resources, Ecological Systems, Waste Proper Disposal, Protection of Public Health, and Valued Species or Places. Institutions and Capacity Building.

Water Governance Systems in Pakistan

Challenges at the Management and Governance Level, Financial Stability and Lack of Investment, Fragmentation and Duplication of Roles and Responsibilities, Technical Capacity and Human Resources, Monitoring, Political Interferences

Recommended Books:

1. Brandon, P. S., & Lombardi, P. (2010). *Evaluating sustainable development in the built environment, 2nd Edition*. John Wiley & Sons, UK.
2. Vezzoli, C., & Manzini, E. (2008). *Design for environmental sustainability*. Springer, London, UK.
3. Fulekar, M. H., Pathak, B., & Kale, R. K. (Eds.). (2014). *Environment and sustainable development*. Springer, India.
4. McKeown, A. E. (Ed.). (2015). *Impact of water pollution on human health and environmental sustainability*. IGI Global.
5. Clini, C., Musu, I., & Gullino, M. L. (2008). *Sustainable development and environmental management*. Springer, Dordrecht, The Netherlands.
6. Baland, J. M., Bardhan, P., & Bowles, S. (Eds.). (2018). *Inequality, cooperation, and environmental sustainability*. Princeton University Press.
7. Callway, R. (2013). *Governance for sustainable development: a foundation for the future*. Earthscan, UK.
8. Goonetilleke, A., Yigitcanlar, T., Ayoko, G. A., & Egodawatta, P. (2014). *Sustainable urban water environment: Climate, pollution and adaptation*. Cheltenham, Edward Elgar, UK.
9. National Water Policy 2018, Pakistan
10. Pakistan's Climate Change Policy
11. Latest Peer Reviewed Research Articles and Reports

ANNEXURE – I

a) Definition of Complex Problem Solving

Engineering problems which cannot be resolved without in- depth engineering knowledge, and have some or all of the characteristics listed below:

Attribute	**Complex Problem**
Depth of knowledge required	**WP1:** 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	**WP2:** Involve wide-ranging or conflicting technical, engineering and other issues.
Depth of analysis required	**WP3:** Have no obvious solution and require abstract thinking and originality in analysis to formulate suitable models.
Familiarity of issues	**WP4:** Involve infrequently encountered issues.
Extent of applicable codes	**WP5:** Outside problems encompassed by standards and codes of practice for professional engineering.
Extent of stakeholder involvement and needs	**WP6:** Involve diverse groups of stakeholders with widely varying needs.
Interdependence	**WP7:** High level problems including many component parts or sub-problems.

b) 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	**EA1:** Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies).
Level of interactions	**EA2:** Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues.
Innovation	**EA3:** Involve creative use of engineering principles and research-based knowledge in novel ways.
Consequences to society and the	**EA4:** Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation.
Familiarity	**EA5:** Can extend beyond previous experiences by applying principles-based approaches.

ANNEXURE – II

Bloom's Taxonomy

Bloom's Taxonomy was created in 1956 under the leadership of educational psychologist Dr Benjamin Bloom (Bloom et al., 1956) in order to promote higher forms of thinking in education, such as analyzing and evaluating concepts, processes, procedures, and principles, rather than just remembering facts (rote learning). It is most often used when designing educational, training, and learning processes.

It is a set of three hierarchical models used to classify educational learning objectives into levels of complexity and specificity. The committee identified three domains of educational activities or learning:

1. Cognitive: mental skills (knowledge)
2. Psychomotor: manual or physical skills (skills)
3. Affective: growth in feelings or emotional areas (attitude or self)

The different sub levels of the above domains, their definitions and sample verbs are presented on following pages.

COGNITIVE DOMAIN
(Thinking, Knowledge)

					CRITICAL THINKING
					Evaluation
				Synthesis	Appraise
			Analysis	Arrange	Argue
		Application	Analyze	Assemble	Assess
	Comprehension	Compute	Categorize	Comply	Attach
Knowledge	Classify	Demonstrate	Compare	Compose	Choose
Arrange	Convert	Discover	Contrast	Construct	Compare
Define	Defend	Dramatize	Criticize	Create	Conclude
Describe	Describe	Employ	Diagram	Design	Contrast
Duplicate	Discuss	Illustrate	Differentiate	Develop	Defend
Identify	Distinguish	Interpret	Discriminate	Devise	Describe
Label	Estimate	Manipulate	Distinguish	Explain	Discriminate
List	Explain	Modify	Examine	Formulate	Estimate
Match	Express	Operate	Experiment	Generate	Evaluate
Memorize	Extend	Practice	Identify	Plan	Explain
Name	Generalized	Predict	Illustrate	Prepare	Judge
Order	Give example(s)	Prepare	Infer	Rearrange	Justify
Outline	Identify	Produce	Model	Reconstruct	Interpret
Recognize	Indicate	Relate	Outline	Relate	Relate
Relate	Infer	Schedule	Point out	Reorganize	Predict
Recall	Locate	Show	Question	Revise	Rate
Repeat	Paraphrase	Sketch	Relate	Rewrite	Select
Reproduce	Predict	Solve	Select	Set up	Summarize
Select	Recognize	Use	Separate	Summarize	Support
State	Rewrite	Write	Subdivide	Synthesize	Value
	Review	Apply	Test	Tell	
	Select			Write	
	Summarize				
	Translate				
LOWER ORDER		***INTERMEDIATE ORDER***		***HIGHER ORDER***	

PSYCHOMOTOR DOMAIN
(Doing, Skills)

Perception	Set	Guided Response	Mechanism	Complete Overt Response	Adaption	Organization
Definition:	***Definition:***	***Definition:***	***Definition:***	***Definition:***	***Definition:***	***Definition:***
Senses cues that guide motor activity.	***Is mentally, emotionally, and physically ready to act.***	***Imitates and practices skills, often in discrete steps.***	**Performs acts with increasing efficiency, confidence, and proficiency.**	***Performs automatically***.	***Adapts skill sets to meet a problem situation.***	***Creates new patterns for specific situations.***
Detect	Achieve a posture	Copy	Complete with Confidence	Act habitually	Adapts	Designs
Hear	Assume a body stance	Duplicate	Conduct	Advance with assurance	Reorganizes	Originates
Listen	Establish a body position	Imitate	Demonstrate	Control	Alters	Combines
Observe	Place hands, arms, etc.	Manipulate with guidance	Execute	Direct	Revises	Composes
Perceive	Position the body	Operate under supervision	Increase efficiency	Excel	Changes	Constructs
Recognize	Sit	Practice	Increase speed	Guide		
See	Stand	Repeat	Make	Maintain efficiency		
Sense	Station	try	Pace	Manage		
Smell			Produce	Master		
Taste			Show dexterity	Organize		
View				Perfect		
Watch				Perform automatically		
				Proceed		

LOWER ORDER	***INTERMEDIATE ORDER***	***HIGHER ORDER***

AFFECTIVE DOMAIN
(Feeling, Attitudes)

Receiving	Responding	Valuing	Organization	Internalizing
Definition:	***Definition:***	***Definition:***	***Definition:***	***Definition:***
Selectively attends to stimuli.	***Responds to stimuli.***	***Attaches value or worth to something.***	***Conceptualizes the value and resolves conflict between it and other values.***	***Integrates the values into a value system that controls behavior.***
Accept Acknowledge Be aware Listen Notice Pay attention Tolerate	Agree to Answer freely Assist Care for Communicate Comply Conform Consent Contribute Cooperative Follow Obey Participate willingly Read voluntarily Respond visit Volunteer	Adopt Assume responsibility Behave according to Choose Commit Desire Exhibit loyalty Express Initiate Prefer Seek Show concern Show continual desire to Use resource to	Adapt Adjust Arrange Balance Classify Conceptualize Formulate Group Organize Rank Theorize	Act upon Advocate Defend Exemplify Influence Justify behavior Maintain Serve Support

LOWER ORDER	***INTERMEDIATE ORDER***	***HIGHER ORDER***