

**CURRICULUM OF  
B.E. (AGR) DEGREE PROGRAM  
UNDER THE OUTCOME-BASED EDUCATION (OBE) SYSTEM**

**Implemented from 2022 (Batch 2K21)  
Submitted to Academic Council through  
Faculty Board of Studies**



**FACULTY OF AGRICULTURAL ENGINEERING  
SINDH AGRICULTURE UNIVERSITY,  
TANDO JAM  
2022**

## 1. Curriculum Structure

Description	Length
Duration	4 Years
Semesters	8
Number of Courses	51 + 2 (thesis)
<b>Total Credit Hours</b>	<b>136 (91+45)</b>
Engineering Domain	98
Non-Engineering Domain	38
Admission requirement	Intermediate with B grade (60%) in Pre-Engineering
No of seats	100

## 2. Vision of the Faculty

To take a leading role in the promotion of technological changes and their management for sustainable agricultural development

## 3. Mission of the Faculty

The mission of the faculty is to strive for excellence in education, research, and outreach in the agricultural sector for sustainable development

## 4. Mission of the Program

The mission of the program is to train and equip the graduates with engineering skills, tools, and techniques so that they be capable of resolving agriculture-related issues for sustainable agricultural development and to strive for excellence in education, research, and outreach in the agricultural sector for sustainable development of the country.

## 5. Program Educational Objectives (PEOs)

**PEO1:** To produce quality graduates acquainted with an in-depth knowledge of engineering principles, tools, and the latest technologies to resolve agricultural engineering-related issues.

**PEO2:** To develop skills in graduates to work independently as well as in diverse teams to provide novel solutions to agriculture-related problems through developing industrial linkages.

**PEO3:** To introduce social, ethical, and environmental boundaries to the graduates within which engineering is practiced both locally and globally.

**PEO4:** To execute and manage teamwork, interpersonal skills, and professional growth.

## 6. Program Learning Outcomes (PLOs)

- PLO1- Engineering Knowledge:** To be able to apply knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PLO2- Problem Analysis:** To be able to identify, formulate, search literature, and analyze complex engineering problems reaching substantiated conclusions using principles of mathematics natural and engineering sciences.
- PLO3- Design/Development of Solutions:** To be able to design solutions for complex engineering problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
- PLO4 - Investigation** To be able to investigate complex engineering problems in a methodical way, including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of the information to derive firm conclusions.
- PLO5- Modern Tool Usage:** To be able to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
- PLO6- The Engineer and Society:** An ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.
- PLO7- Environment and Sustainability:** To be able to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of, and need for, sustainable development.
- PLO8- Ethics:** To be able to apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
- PLO9- Individual and Teamwork:** To be able to work effectively, as an individual or in a team, in multifaceted and /or multidisciplinary settings.
- PLO10- Communication:** An ability to communicate effectively, orally as well as in writing, on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PLO11- Project Management:** An ability to demonstrate management skills and apply engineering principles to one's own work to manage projects in a multidisciplinary environment as a member and/or leader in a team.

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

## 7. Course Learning Outcomes (CLOs)

The Course Learning Outcomes (CLOs) are clear and concise statements that define what our students will learn from a particular course. CLOs statements describe the knowledge, skills, intellectual abilities, and/or values or attitudes that students will own after completing a particular course.

For each course of the program, CLOs are defined as part of the course curriculum. The level of learning is also defined for each of the CLO. The learning levels are based on Bloom's Taxonomy. The CLOs cover all three learning domains of Bloom's Taxonomy: cognitive, affective, and psychomotor. The cognitive domain (knowledge) refers to knowledge attainment and mental/intellectual processes. The affective domain (attitudes) characterizes the emotional arena reflected by learners' beliefs, values, and interests. The psychomotor domain (skills) reflects learning behavior achieved through neuromuscular motor activities. The mapping of CLOs to PLOs ensures the attainment of PLOs for the degree. The CLOs in the Faculty are assessed based on the following Key Performance Indicators (KPIs)

**Table 1:** KPIs for CLO Assessment

OBE Assessment	Measurement Tool	KPI	Measurement Time
Course Learning Outcome (CLO)	Assignments, quizzes, presentations, viva voce, mid and final exams etc.	Obtained at least 40% marks in a CLO	At the end of the semester

## 8. Admission Policy

As per University's admission policy, the applications are invited every year through advertisements in local and national newspapers. Students passing HSC with at least in B grade (60%) in Pre-Engineering are eligible to apply for B.E (Agri) degree program. All the seats are filled strictly on merit (an entry test is conducted). A few quota seats are processed separately on merit as well.

**SUMMARY OF COURSES OFFERED IN  
B.E. (AGRI) DEGREE PROGRAM  
UNDER THE OUTCOME BASED EDUCATION (OBE) SYSTEM  
(Implemented From 2022, Batch-2K21)**

<b>1<sup>st</sup> SEMESTER</b>			
<b>Sr.#</b>	<b>Code</b>	<b>Title</b>	<b>Credit</b>
1	AG-101	Basic Agriculture	2(1 - 1)
2	BE-103	Calculus and Analytical Geometry	3(3 - 0)
3	FPM-105	Metallurgy & Workshop Practices	3(2 - 1)
4	LWM-107	Soil Science	3(2 - 1)
5	EE-109	Industrial Chemistry	2(1 - 1)
6	PS-111	Pak Studies and Global Perspective	2(2 - 0)
7	IT-113	Information & Communication Technologies	3(2 - 1)
<b>Total</b>			<b>18(13- 5)</b>
<b>2<sup>nd</sup> SEMESTER</b>			
1	BE-102	Applied Physics	3(2 - 1)
2	BE-104	Linear Algebra	3(3 - 0)
3	FPM-106	Engineering Drawing & Graphics	2(1 - 1)
4	ID-108	Farm Irrigation Systems	2(1 - 1)
5	LWM-110	Surveying and Levelling	3(1 - 2)
6	FS-112	Engineering Materials	2(1 - 1)
7	ENG-114	Functional English	2(2 - 0)
<b>Total</b>			<b>17(11 – 6)</b>
<b>3<sup>rd</sup> SEMESTER</b>			
1	BE-201	Engineering Mechanics	3(2 - 1)
2	FPM-203	Applied Thermodynamics	2(1 - 1)
3	ID-205	Engineering Hydrology	3(2 - 1)
4	EE-207	Climate Change & Water	2(1 - 1)
5	FS-209	Strength of Materials	3(2 – 1)
6	ENG-211	Communication Skills	2(2 - 0)
7	IS-213	Islamic Studies and Ethics	2(2 - 0)
<b>Total</b>			<b>17(12 – 5)</b>
<b>4<sup>th</sup> SEMESTER</b>			
1	BE-202	Differential Equations	3(3 – 0)
2	FPM-204	IC Engines and Tractors	3(2 – 1)
3	ID-206	Fluid Mechanics	3(2 – 1)
4	LWM-208	GIS & Remote Sensing	2(1 – 1)
5	EE-210	Environmental Engineering	3(2 - 1)
6	SE-212	Social Sci Elective-I (Sociology for Engineers)	2(2 – 0)
7	IT-214	Artificial Intelligence (AI)	2(1 – 1)
<b>Total</b>			<b>18(13 – 5)</b>
<b>5<sup>th</sup> SEMESTER</b>			
1	BE-301	Numerical Analysis	2(2 - 0)
2	FPM-303	Machine Design	3(2 – 1)
3	ID-305	Open Channel Hydraulics	3(2 – 1)

4	LWM-307	Soil Mechanics	3(2 - 1)
5	FS-309	Rural Electrification	2(1 - 1)
6	EC-311	Management Elective-I (Entrepreneurship)	2(2 - 0)
7	STAT-313	Probability and Statistics	3(3 - 0)
<b>Total</b>			<b>18(14 - 4)</b>
<b>6<sup>th</sup> SEMESTER</b>			
1	FPM-302	Farm Machinery and Automation	3(2 - 1)
2	FPM-304	Instrumentation and Control	2(1 - 1)
3	ID-306	Pumps and Tubewells	2(1 - 1)
4	EE-308	MDE Elective-I (Wastewater Engineering)	3 (2 - 1)
5	FS-310	Engg. Elective-I (Landscape Engineering)	2(1 - 1)
6	EC-312	Social Sci. Elective-I (Economics for Engineers)	2(2 - 0)
7	ENG-314	Technical Writing and Presentation Skills	2(2 - 0)
<b>Total</b>			<b>16(11 - 5)</b>
<b>7<sup>th</sup> SEMESTER</b>			
1	FPM-401	Earth Moving Machinery	2 (1 - 1)
2	ID-403	Irrigation Engineering	3(2 - 1)
3	LWM-405	Engg. Elective-II (Soil and Water Conservation Engineering)	3(2 - 1)
4	EE- 407	Solid Waste Management	3(2 - 1)
5	FS-409	Farm Structures and Control Sheds	3(2 - 1)
6	AE-411	Final Year Design Project (FYDP)-I	3(0 - 3)
	AE-413	Internship (6 to 8 weeks)	0(0 - 0)
<b>Total</b>			<b>17(9 - 8)</b>
<b>8<sup>th</sup> SEMESTER</b>			
1	ID-402	Drainage Engineering	3(2 - 1)
2	LWM-404	Engg. Elective-III (Farm Water Management)	3(2 - 1)
3	FS-406	Agricultural Process Engineering	3(2 - 1)
4	EE-408	MDE Elective-II (Alternate and Renewable Energy)	3(2 - 1)
5	AE-412	Final Year Design Project (FYDP)-II	3(0 - 3)
<b>Total</b>			<b>15(8 - 7)</b>
<b>Gross Total Credit Hours</b>			<b>136(91-45)</b>

## Department-wise Course Distribution

### Department of Irrigation & Drainage

<b>ODD SEMESTER</b>					
S#	Code	Title	Total Cr. H	Th	Pr
1	ID-205	Engineering Hydrology	3	2	1
2	ID-305	Open Channel Hydraulics	3	2	1
3	ID-403	Irrigation Engineering	3	2	1
<b>Total</b>			<b>9</b>	<b>6</b>	<b>3</b>

<b>EVEN SEMESTER</b>					
S#	Code	Title	Total Cr. H	Th	Pr
1	ID-108	Farm Irrigation Systems	2	1	1
2	ID-206	Fluid Mechanics	3	2	1
3	ID-306	Pumps and Tubewells	2	1	1
4	ID-402	Drainage Engineering	3	2	1
<b>Total</b>			<b>10</b>	<b>6</b>	<b>4</b>

### Department of Farm Power & Machinery

<b>ODD SEMESTER</b>					
S #	Code	Title	Total Cr. H	Th	Pr
1	FPM-105	Metallurgy & Workshop Practices	3	2	1
2	FPM-203	Applied Thermodynamics	2	1	1
3	FPM-303	Machine Design	3	2	1
4	FPM-401	Earth Moving Machinery	2	1	1
<b>Total</b>			<b>10</b>	<b>6</b>	<b>4</b>

<b>EVEN SEMESTER</b>					
S #	Code	Title	Total Cr. H	Th	Pr
1	FPM-106	Engineering Drawing & Graphics	2	1	1
2	FPM-204	IC Engines and Tractors	3	2	1
3	FPM-302	Farm Machinery and Automation	3	2	1
4	FPM-304	Instrumentation and Control	2	1	1
<b>Total</b>			<b>10</b>	<b>6</b>	<b>4</b>

## Department of Land and Water Management

<b>ODD SEMESTER</b>					
S#	Code	Title	Total Cr. H	Th	Pr
1	LWM-107	Soil Science	3	2	1
2	LWM-307	Soil Mechanics	3	2	1
3	LWM-405	Engg. Elective-II (Soil and Water Conservation Engineering)	3	2	1
<b>Total</b>			<b>9</b>	<b>6</b>	<b>3</b>

<b>EVEN SEMESTER</b>					
S#	Code	Title	Total Cr. H	Th	Pr
1	LWM-110	Surveying and Levelling	3	1	2
2	LWM-208	GIS & Remote Sensing	2	1	1
3	LWM-404	Engg. Elective-III (Farm Water Management)	3	2	1
<b>Total</b>			<b>8</b>	<b>4</b>	<b>4</b>

## Department of Farm Structures

<b>ODD SEMESTER</b>					
S #	Code	Title	Total Cr. H	Th.	Pract.
1	FS-209	Strength of Materials	3	2	1
2	FS-309	Rural Electrification	2	1	1
3	FS-409	Farm Structures and Control Sheds	3	2	1
<b>Total</b>			<b>8</b>	<b>5</b>	<b>3</b>

<b>EVEN SEMESTER</b>					
S#	Code	Title	Total Cr. H	Th.	Pract.
1	FS-112	Engineering Materials	2	1	1
2	FS-310	Engg. Elective-I (Landscape Engineering)	2	1	1
3	FS-406	Agricultural Process Engineering	3	2	1
<b>Total</b>			<b>7</b>	<b>4</b>	<b>3</b>



## Department of Environment and Energy

S #	Code	Title	Total Cr. H	Th	Pr
1	EE-109	Industrial Chemistry	2	1	1
2	EE-207	Climate Change & Water	2	1	1
3	EE- 407	Solid Waste Management	3	2	1
<b>Total</b>			<b>7</b>	<b>4</b>	<b>3</b>

S#	Code	Title	Total Cr. H	Th	Pr
1	EE-210	Environmental Engineering	3	2	1
2	EE-308	MDE Elective-I (Wastewater Engineering)	3	2	1
3	EE-408	MDE Elective-II (Alternate and Renewable Energy)	3	2	1
<b>Total</b>			<b>9</b>	<b>6</b>	<b>3</b>

## IT Related Courses

ODD SEMESTER					
S#	Code	Title	Total Cr. H	Th	Pr
1	IT-113	Information & Communication Technologies	3	2	1
<b>Total</b>			<b>3</b>	<b>2</b>	<b>1</b>

EVEN SEMESTER					
S#	Code	Title	Total Cr. H	Th	Pr
1	IT-214	Artificial Intelligence (AI)	2	1	1
<b>Total</b>			<b>2</b>	<b>1</b>	<b>1</b>

## NON-ENGINEERING SUPPORTING COURSES

### Department of Basic Engineering

<b>ODD SEMESTER</b>					
S #	Code	Title	Total Cr. H	Th	Pr
1	BE-103	Calculus and Analytical Geometry	3	3	0
2	BE-201	Engineering Mechanics	3	2	1
3	BE-301	Numerical Analysis	2	2	0
<b>Total</b>			<b>8</b>	<b>7</b>	<b>1</b>

<b>EVEN SEMESTER</b>					
S#	Code	Title	Total Cr. H	Th	Pr
1	BE-102	Applied Physics	3	2	1
2	BE-104	Linear Algebra	3	3	0
3	BE-202	Differential Equations	3	3	0
<b>Total</b>			<b>9</b>	<b>8</b>	<b>1</b>

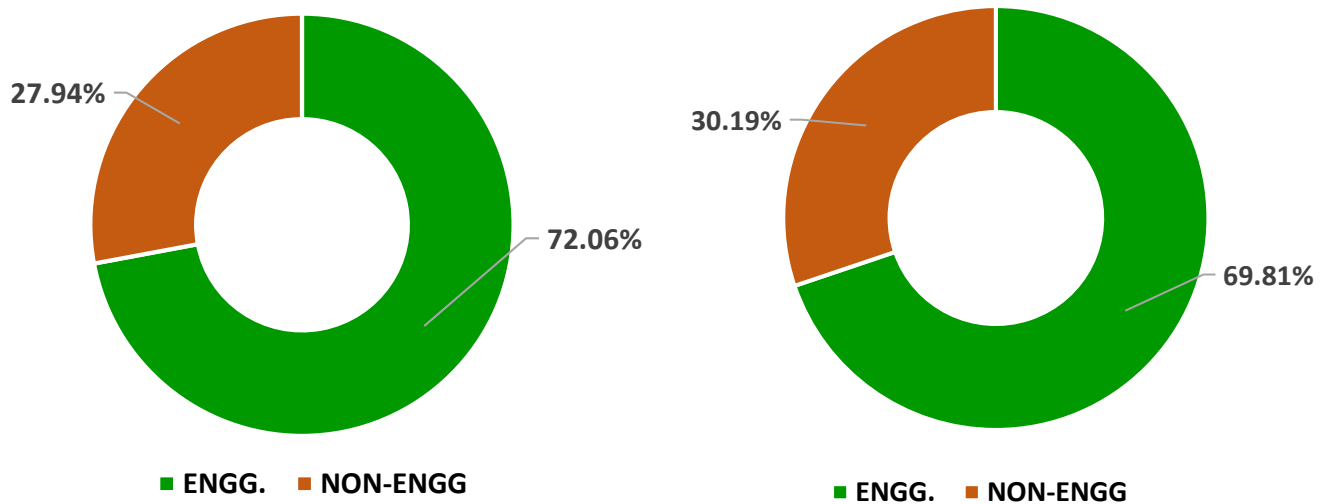
### Other Departments

<b>ODD SEMESTER</b>					
S #	Code	Title	Total Cr. H	Th	Pr
1	AG-101	Basic Agriculture	2	1	1
2	PS-111	Pak Studies and Global Perspective	2	2	0
3	ENG-211	Communication Skills	2	2	0
4	IS-213	Islamic Studies and Ethics	2	2	0
5	EC-311	Management Elective-I (Entrepreneurship)	2	2	0
6	STAT-313	Probability and Statistics	3	3	0
<b>Total</b>			<b>13</b>	<b>12</b>	<b>1</b>

<b>EVEN SEMESTER</b>					
S#	Code	Title	Total Cr. H	Th	Pr
1	ENG-114	Functional English	2	2	0
2	SE-212	Social Sci Elective-I (Sociology for Engineers)	2	2	0
3	EC-312	Management Elective-I (Entrepreneurship)	2	2	0
4	ENG-314	Technical Writing and Presentation Skills	2	2	0
<b>Total</b>			<b>8</b>	<b>8</b>	<b>0</b>

**SUMMARY OF DEPARTMENT WISE COURSES & CREDIT HOURS  
AS PER REVISED SYLLABUS-2022**

Department	Odd Semester			Even Semester			Total	No. of courses
	TH	PR	Total	TH	PR	Total		
<b>I &amp; D</b>	6	3	<b>9</b>	6	4	<b>10</b>	<b>19</b>	7
<b>FPM</b>	6	4	<b>10</b>	6	4	<b>10</b>	<b>20</b>	8
<b>LWM</b>	6	3	<b>9</b>	4	4	<b>8</b>	<b>17</b>	6
<b>EE</b>	4	3	<b>7</b>	6	3	<b>9</b>	<b>16</b>	6
<b>FS</b>	5	3	<b>8</b>	4	3	<b>7</b>	<b>15</b>	6
<b>INTERN</b>	0	0	<b>0</b>	0	0	<b>0</b>	<b>0</b>	0
<b>IT</b>	2	1	<b>3</b>	1	1	<b>2</b>	<b>5</b>	2
<b>PROJECT</b>	0	3	<b>3</b>	0	3	<b>3</b>	<b>6</b>	2
<b>Sub-Total</b>	<b>29</b>	<b>20</b>	<b>49</b>	<b>27</b>	<b>22</b>	<b>49</b>	<b>98</b>	<b>37</b>
<b>Non-Eng. domain</b>	12	1	<b>13</b>	8	0	<b>8</b>	<b>21</b>	10
<b>BE (non-Eng. Domain)</b>	7	1	<b>8</b>	8	1	<b>9</b>	<b>17</b>	6
<b>Sub Total</b>	19	2	<b>21</b>	16	1	<b>17</b>	<b>38</b>	<b>16</b>
<b>G. Total</b>	<b>48</b>	<b>22</b>	<b>70</b>	<b>43</b>	<b>23</b>	<b>66</b>	<b>136</b>	<b>53</b>



**Fig. 1:** Donut graphs of (a) percentage of Engineering and non-Engineering credit hours and (b) number of courses

# SEMESTER-WISE COURSE CONTENTS

## SEMESTER-I

**AG-101**

**Basic Agriculture**

**2(1 - 1)**

**Introduction:** Introduction to the Engineering Profession and its Fields of Specialization with particular emphasis on Agricultural Engineering. **Crop Production:** Major crops of Pakistan, Factors affecting crop production and distribution. Requirements for agricultural development. Classification of field crops based on agronomic use, special purpose, and another basis. **Seed Technology:** Role of seed in crop production. Concept of seed technology. Seed Structure and growth, Dormancy, Seed Production and its quality, Seed Processing and Seed Storage. **Farming Systems and Tillage Practices:** Crop rotation. Definition and computation of cropping intensity. Farming systems and its kinds. Objectives of tillage. Effect of tillage on soil conditions, plant diseases and insects. **Dry Land Farming:** Introduction, Importance, Rainfall pattern, Barani cultivation practices, Barani Agro-ecological zones, Problems and constraints of dry land, Dry land improvement, Dry land management, Barani cropping system. **Land Resources and Management:** Soil zones and Soil resources of Pakistan. Sustainability of land resources. Managing soil resources. **Agro-Meteorology:** Introduction, Weather and climate, Climatic components, Classification of climates, Climatic factors, and crop production. **Agro-Ecology:** Introduction, Agro-ecological Features of Pakistan, Agro-ecological zones, Agroecology of Punjab.

### **Teaching Methodology (Proposed as applicable):**

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

### **Assessment:**

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

### **Suggested Books:**

- i. Nazir, S. 1994. Crop Production. National Book Foundation, Islamabad.
- ii. Martin, J. H., W. H. Leonard, and D. L. Stamp. 1990. Principles of Field Crop Production, 3rd edition. Macmillan Co. Inc New York
- iii. AW Khoso. 1992. Crops of Sindh. SAU Tandojam.

**BE-103**

**Calculus and Analytical Geometry**

**3(3-0)**

**Analytical Geometry:** Review of vectors, scalars and vector products, Three-dimensional coordinate system and equation of straight line and plane. **Functions Limit and Continuity:** Review of functions and graphs, Limits & Continuity, Techniques of Finding Limits, Discontinuity, Limits of Sine and Cosine and Exponential Functions. **Differentiation:** Introduction to Derivatives, Examples of Derivatives, Derivative as Rate of Change, Derivative's Rules, Implicit Differentiation, Higher order derivatives, Leibnitz Theorem. **Applications of Derivatives:** Applications of Derivatives, Monotonic functions, Optimization problems, Relative and Absolute extrema, First and second derivative tests, Point of inflection, Concavity, Curvature, Indeterminate Forms and L' Hospital rule, Differentials. **Integration:** Integrals and Properties of Integrals, Techniques of Integration, Integration by Parts, Definite Integrals, Integration of Trigonometric, Exponential and Inverse Functions, Integration by Partial Fractions, Reduction Rules. **Applications of Integration:** Applications of Integration, Area under the curve, Area between curves, Solids of Revolution, Volume of Solids of revolution by disk, Washer, Cylindrical shell & Cross Section Methods, Center of Pressure and Depth of Center of Pressure, Center of mass, Arc length. **Improper Integrals:** Improper Integral, Integrals and Singularities, Convergence of improper integrals. **Infinite Sequence and Series:** Sequence and Infinite Series, Convergence and Divergence of sequences and series, Positive Term Series, Integral Test, Basic Comparison Test, Limit Comparison Test, Ratio and Root tests, Alternating series, Absolute and Conditional Convergence. **Power and Taylor Series:** Power series, Maclaurin and Taylor Series and its Applications.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment**

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

**Suggested Books:**

- i. Swokowski, Onlinick & Pence: Calculus
- ii. Robert T. Smith & Roland B. Minton: Calculus
- iii. Calculus: Early Transcendentals by James Stewart. Brooks/Cole USA
- iv. Thomas' Calculus by George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass, Pearson, USA.

**FPM-105****Metallurgy & Workshop Practices****3(2-1)**

**Introduction:** safety rules for workshop practices, identification of the different tools available in the workshops (screw drivers, pliers, spanners, hammers, chisels etc.), production and properties of common engineering materials, properties of ferrous metals and non-ferrous metals, manufacturing processes of Iron and steel. **Non-metallic Materials:** Composition, properties, and usage, plastics and rubber, fiber glass and composite materials. **Alloy Steel and Irons:** effect of alloying elements, AISI/SAE alloy steel and their identification, corrosion-resistant steel, steel for high temperature services, alloy steel. **Non-ferrous Metals:** properties and usage, copper, aluminum, zinc, tin, nickel, and lead, non-ferrous alloys, Copper alloys. Aluminum alloys, Zinc base alloys, nickel-base alloys, Lead-tin alloys, iron-carbon equilibrium diagram. **Heat Treatment:** heat treatment theory and process, heat treatment of steel, heat treatment equipment. **Foundry:** definition, importance, advantages and disadvantages of foundry, casting, hand molding tools, characteristics of molding sand, foundry cores, properties of core and crucibles, handling and care, Copula furnace, construction, zone of copula and its advantages. **Lathe Machines:** Describe turning and related operations commonly performed on lathe machines, demonstrate the different types and construction of lathe and its accessories, carry out different lathe operations, illustrate turret lathe and turret lathe tooling, demonstrate the mechanism of chip formation, describe different types of cutting tools and their materials, discuss the tool failure, tool life and the use of coolants. **Drilling, Reaming and Grinding:** Explain and illustrate different types of drilling machines, drill bits and drill chucks, carry out counterboring and sinking, discuss and illustrate boring and reaming practices and tools, carry out the estimation of drilling time. **Milling:** Describe the different types and working principles of milling machines, demonstrate and discuss milling operations and mill cutters, carry out the estimation of milling time. **Shaping and Planning:** Discuss types and applications of shapers and planers, explain the shaper drive mechanism, demonstrate and describe shaper speeds and machining times, discuss the construction and types of planning, machines, illustrate planer tools and work set up methods, demonstrate and discuss metal bending and sheet rolling processes. **Welding:** definition, types of the welding process, a survey of welding equipment, Arc welding; welding materials, inspection and testing of welded joints, gas welding. **Safety and First Aid:** Safety in the shop, mechanical and other accidents, safety devices, safety methods, first aid equipment and methods, care, and order in the workshop

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- i. John, K.C. 2011. Mechanical Workshop Practice. PHI Learning Pvt. Ltd.
- ii. Sharma, S. 2010. Manufacturing Processes. I.K. International Publishing House, New Delhi, India.
- iii. Abbaschian, R., Abbaschian, L., and R.E. Reed-Hill, 2009. Physical Metallurgy Principles. 4th Ed. Cengage Learning, USA.
- iv. Chapman, W.A.J. 2004. Workshop Technology Part-I and II. Viva Books Private Ltd., India.

**Soil Perspective:** What is soil? Edaphology and Pedology, A field view of soil, Soil profile, Subsoil and Surface soil, Mineral vs. Organic soils. Four major Components of Soils, Mineral constituents in soils, Soil organic matter, Soil water, Soil air, clay, and humus. **Important Physical Properties of Mineral Soils:** Soil texture and Soil Structure, Classification of soil particles, Physical nature of soil separates, Soil texture classes. Mechanical analysis, Preparation of the Sample, Factors affecting dispersion, Methods for obtaining dispersion, Fractionation of the sample, Sieve method. Stokes' Law. Sedimentation methods, Determination of soil class, Particle and Bulk Density, Pore Space, Structure of mineral soils, Aggregation and its promotion, Structural management of soil, Soil Consistence. **Soil Colloids:** General constitution of Silicate clays, Adsorbed cations, Silicate clay structure, Classification of Silicate clays, Chemical Composition of silicate clays, Cation exchange capacity of soils, Plasticity, Cohesion, Swelling, Shrinkage, Dispersion and Flocculation. **Soil Water:** Structure and related properties of water, Soil water energy concept, Soil Moisture content versus Suction, Measuring Soil moisture, Capillary Fundamentals, Types of soil water movement, Saturated flow through soils, unsaturated flow in soils, Retention of soil moisture in the field, Conventional soil moisture classification, Factors affecting the amount and use of available soil moisture, Capillarity, and root extension. **Soil Air and Soil Temperature:** Soil aeration definition, soil aeration problems in the field, Composition of soil air. Factors affecting the Composition of soil air, Fick's Law, Aeration in relation to soil and crop management. Soil temperature, Specific Heat of soils, Volumetric Heat Capacity, Thermal diffusivity, and Conductivity, Fourier's Law, Movement of Heat in soil, Soil temperature control. **Plant Nutrients and Fertilizers:** Factors controlling the growth of higher plants, The essential elements from the air, water and soil, Soil solution, Soil and plant interrelations, fertilizer elements, Nitrogen Fertilizers, Phosphates Fertilizers, Potassium Fertilizers, Mixed Fertilizers, Methods of applying solid fertilizers, Application of liquid Fertilizers. **Saline and Sodic Soils:** Climate and salinity, Some basic terms, Saline, Saline alkali and Sodic Soils, Diagnosis of Saline and Sodic Soils, Reclamation Steps of Salt-affected soils, Leaching Requirements, Crop tolerance to Salinity.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

An overview of Chemical Industry and Large-Scale Manufacturing: Background factors in large scale processes. Impurities in natural water, hard water, water softening, boiler scales and deposits, industrial and municipal water, metallic corrosion and its inhibition, paints and varnishes, fats and oils, extraction, refining and hydrogenation of oils. **Inorganic Processes in Industry:** Wet process Phosphoric Acid and Superphosphates, thermal process for Phosphoric acid, Ammonia, Sulfuric acid, Nitric acid, Sodium hydroxide and Chlorine. **Products of Fermentation Processes:** Background for fermentation processes for industrial chemicals and sewage treatment, industrial fermentations using aerobic and anaerobic methods, water-an important raw material for the chemical industry. **Organic Chemical Processes:** Conversion for petroleum into purified chemical substances, industrial processes using Ethylene and Propylene chemistry, Butene fraction of refinery streams, industrial chemicals from Benzene, Toluene, Xylenes, Methane. The environmental impact of industrial processes causing atmospheric and soil pollution.

**Practical:**

1. Determination of carbonates and bicarbonates in industrial water
2. Determination of chlorides and sulphates in industrial water
3. Determination of pH and TSS in water
4. Estimation of nitrogen, phosphorus, and potassium in fertilizers
5. Analysis of oil for acid, saponification, and iodine value.

**Suggested Books:**

- i. Howrad, L. White (1986). Introduction to Industrial Chemistry, Wiley-InterScience
- ii. Agarwal, O.P., A. Agarwal, 2001. Engineering Chemistry. Khanna Publishers, India.
- iii. Kent, A.J. 1997. Riegel's Handbook of Industrial Chemistry. CBS Publisher New Delhi, India.
- iv. Shreve, R.H.1987.The Chemical Process Industries. McGraw-Hill Book Co., New York

**PS-111****Pak Studies and Global Perspective****2(2 - 0)**

**Historical and Ideological Perspective:** Pakistan Movement, Aligarh Movement, Two Nations Theory, Founders of Pakistan: Allama Muhammad Iqbal, Quaid-e-Azam Muhammad Ali Jinnah, Other Leaders (Women and other Pakistan Movement Leaders). Quaid's Vision for Pakistan, Kashmir – An unfinished Agenda of Partition. **Constitution of Pakistan:** An overview of constitutional development in Pakistan, Salient features of the Constitution of 1973, Constitutional Amendments, Fundamental Rights and Responsibilities of Citizens. **Contemporary Pakistan:** Pakistan's society, culture, and demography – celebrating diversity, Current Challenges: social, economic, environmental, political, and external, Nation's resilience in War on Terror. **Economy of Pakistan:** An overview of Economy, Services, Manufacturing and Agricultural Profile of Pakistan, Regional Economic Cooperation, One Belt One Road (OBOR) – CPEC. **Land of Opportunities:** Physical features: diversity and beauty, Natural resources - mineral, water, energy, agriculture & livestock, and marine resources, Tourism and Culture. **Pakistan's Foreign Policy:** Foreign Policy – Principles and Objectives, Relations with Neighbors, Major Economies, Muslim World, Geo-political and strategic significance of Pakistan in Regional and, Global Politics. **Pakistan in pursuit of Global Agenda:** SDGs-2030 - Pakistan Goals, Commitments on Climate Change, Peace and Security.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- i. Khalid B. Sayeed, Pakistan: The Formative Phase 1857 – 1948, Pakistan Publishing House, 1960
- ii. Gulam Allana, Quaid-e-Azam: the story of Pakistan, Ferozsons, 1967.
- iii. Shahid M. Amin, Pakistan's Foreign Policy: A Reappraisal, Oxford University Press, 2010
- iv. S. Akbar Zaidi, Issues in Pakistan's economy, Oxford University Press, 2003
- v. Hamid Khan, Constitutional & political history of Pakistan, Oxford University Press, 2003
- vi. Rafi Raza, Pakistan in Perspective 1947-1997, Oxford University Press
- vii. Pakistan's Foreign Policy: A Reappraisal by Shahid M. Amin. ISBN:0195798015
- viii. Newspaper's editorial and selected journalistic writings on current affairs
- ix. Pakistan (Lands, Peoples, & Cultures) by Carolyn Black, Bobbie Kalman. ISBN: 0778797147.

**IT-113****Information and Communication Technologies (ICT)****3(2 – 1)**

**Introducing Computer Systems: Basic Definitions of** Computer and Communication Technology and the applications of ICT - particularly for Engineers. **Basic Operations and Components of a Generic Computer System:** Basic operations: Input, Processing, Output, Storage Basic components: Hardware, Software, Data, Users, Types of storage devices. **Processing Data:** Transforming data into information, how computers represent and process data, processing devices, CPU architectures. **The Internet:** The

Internet and the World Wide Web- browsers, HTML, URLs/ How DNS works, Email, and other programs. **Introduction to Embedded Systems:** What is an Embedded System, Applications, Components, Programming Languages, Popular Development Platforms. **Networking Basics:** Uses of networks, Common types of networks (LAN, WAN, MAN etc.), Introduction to OSI Model, Future of Networks. **Database Management:** Hierarchy of Data, Maintaining Data, Database Management Systems. **Protecting your Privacy, your computer, and your Data:** Basic Security Concepts, Threats to users, Threats to hardware, Threats to Data.

**Tools / Software Requirement:**

Microsoft Office, Windows, Virtual Box, NetBeans

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

**Assessment:**

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

**Suggested Books:**

- i. Peter Norton. 2013. Introduction to Computers. 7th Edition, McGraw-Hill.
- ii. Timothy O’Leary and Linda O’Leary. 2010. Computing Essentials. McGraw-Hill.
- iii. Williams Sawyer. 2005. Using Information Technology: A Practical Introduction to Computers & Communications. 6th Edition, McGraw-Hill.
- iv. Shelly GB, Vermaat ME. 2012. Discovering Computers, Complete: You’re Interactive Guide to the Digital World. Cengage Learning.



## SEMESTER-II

**BE-102**

**Applied Physics**

**3(2 – 1)**

**Introduction:** Review of vectors, ordinary differentiation of vector, gradient of scalar field, divergence, and curl of vector field. line, surface, and volume integrals with their applications. **Mechanics:** Newton laws and their applications (simple accelerometer, banked curve, and rotor), frictional forces and determination of co-efficient of friction, work energy theorem, applications of law of conservation of energy, angular momentum, center of mass of two-particles, many-particles and solid object. **Thermodynamics:** Laws of thermodynamics and heat transfer mechanisms, heat and work, kinetic theory of gases, ideal gases, mean free path, distribution of molecular speeds, change in entropy and irreversible processes. **Electricity & Magnetism:** Electric field due to discrete and continuous charge distributions, electrostatic potential of discrete and continuous charges, gauss's law and its applications, Lorentz force and hall effect, ampere's law, magnetic field due to current element (circular current loop and solenoid). **Waves & Oscillations:** Types of waves and superposition principle, wave speed on a stretched string, wave equation, energy & power of a wave, principle of superposition and standing waves. simple harmonic oscillations. forced & damped oscillations. **Atomic and Nuclear Physics:** Planck's explanations of black body radiation, photoelectric effect, Compton effect, de-Broglie hypothesis, x-rays and Moseley's law, atomic nucleus and properties of nucleus, radioactive decay, and radioactive dating. **Soil Physics:** Thermal and physical properties of soil; factor affecting; heat flow equations, transport of gases and water vapors through soil, transport of inert, non-adsorbing and adsorbing chemicals in soil, volatile organic compounds transport in soil.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**BE-104**

**Linear Algebra**

**3(3 – 0)**

**Introduction (System of Linear Equations and Applications):** Overview of linear system of equations, cases of unique solution, no solution and infinite solutions, echelon form, gauss elimination method, inversion of matrix in the context of solution of system of equations, factorization, row space and column space, relevant engineering case studies such as network analysis, traffic flows, balancing chemical reaction, Leontief input-output model, finding max stress in compound cylinder, applications of linear systems in force balancing of structures, Markov process. **Vector Spaces and Transformations:** Real vector spaces, subspaces, basis and dimension, rank, nullity gram-Schmidt process for finding orthonormal basis linear transformation, kernel of transformation, range of transformation, matrix of transformation, applications: cryptography, coding and decoding, breaking of codes, robotic applications of linear transformations. **Eigenvalues and Eigen Vectors:** Eigenvalues, eigenvectors, similar matrices, diagonalization, quadratic forms, positive definite matrices, singular value, decomposition, inner product

spaces. applications of linear algebra: constructing curves and surfaces, computer graphics, genetics. **Linear Programming:** Solution introduction to linear programming, optimization, graphical method, simplex method, optimization problems in engineering and economics. dual simplex methods, duality theory, primal and dual problems, transportation models, north-west corner, least-cost and Vogel's approximations methods, assignment model, the transshipment model and other relevant engineering case studies. **Application of Linear Algebra in Dynamical Systems:** Numerical system of linear odes, eigenvalue problems, homogeneous and nonhomogeneous system of ODE dynamical systems, population dynamics, prey-predator models, stability analysis.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**FPM-106**

**Engineering Drawing & Graphics**

**2(1 – 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 off points, projections of straight lines, Projections of planes and solids in simple position, sectioning of solids, Isometric projections, development of surfaces.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**ID-108**

**Farm Irrigation Systems**

**2(1 – 1)**

**History of Irrigation:** Scope of Irrigation in Pakistan, Farm Irrigation Systems, **Systems Design Fundamentals:** Functions of farm irrigation systems, Types of farm irrigation systems, Conveyance methods, Design of farm irrigation systems, Data for design, Water source evaluation, Determination of daily design requirements, **Crop Water Requirements:** Pan Evaporation Method, Blaney Criddle Method, Hargreaves and Samani equation, FAO Radiation, FAO Blaney–Criddle Method, Penman-Monteith Method, Jansen Haise Method, Modified Penman-Monteith Method (Cropwat Model), Water Balance Approach, Crop Coefficients, Evapotranspiration, **Plant-Water-Soil Relationship:** Infiltration Measurement Methods, Green and Ampt Model, Horton's Equation, Kostiaikov Method, Richard's Equation, Double Ring Infiltrometer Test, Total Soil Moisture Potential, Soil Moisture Retention Curves, Soil Moisture Measurement Methods, Soil Analysis, Sieve Analysis, Pressure Membrane Apparatus. **Surface Irrigation:** Different methods of surface irrigation, Furrow irrigation, Border irrigation, Basin irrigation, Design of furrow, border, and basin irrigation systems. **Design of HEIS Irrigation:** History and Scope in Pakistan, Components of Trickle irrigation system, Head Unit, Filtration system requirement for HEIS, Fertigation system for HEIS, Design of Trickle Irrigation System for different crops. **Sprinkle Irrigation System:**

Types of sprinkler system, Components of sprinkler system, Pressure requirement of Sprinkler irrigation, Design of Sprinkler Irrigation System.

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

**Assessment:**

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

**Suggested Books:**

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

**LWM-110**

**Surveying and Levelling**

**3(1 – 2)**

**Introduction to Surveying and Leveling (Surveying Instruments):** Chains, tapes, steel bands, their types and uses, chain surveying: ranging and chaining of survey lines, fieldwork and plotting of chain survey.

**Compass Surveying:** Prismatic compass and surveyor compass, uses, bearing, local attraction, fieldwork and plotting, plane table surveying, parts and accessories, methods of surveying, two-point and three-point problems. **Leveling:** General principle, types of levels and their temporary and permanent, adjustments, methods of leveling, reduction of level, precise leveling and trigonometric leveling. **Theodolite:** Types and uses of theodolites, temporary and permanent adjustments, measurement of horizontal and vertical angles. **Tachometric Surveying:** Methods of tachometric surveying, fieldwork, and computations. **Traversing:** Traversing with prismatic compass, theodolite and plane table, computations and adjustments of traverse, transformation of coordinates, calculation of areas and volumes: earth work calculation, d.m.d method, Simpson rule and trapezoidal rule, total station, and GPS.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**FS-112**

**Engineering Materials**

**2(1 – 1)**

**Introduction and Classification of Materials Stones:** Classification and characteristics of good building stones, tests of stones, quarrying and dressing of stones, artificial stones and its varieties, preservation of stonework. **Tiles and Bricks:** Different kinds of tiles, manufacturing and uses of tiles, coloring and glazing of tiles, fire tiles and bricks kiln (traditional and zigzag technology), 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, methods of corrosion control, comparison of the construction materials strength. **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.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Haider, S.Z. 1985 Materials of Construction (2nd edition), Oxford University Press, Pakistan
- Surendra S. 1990 Engineering Materials. Vikas Publishing House (Pvt.) Ltd. 5 Ansari Road, New Delhi 110002
- Kulkarni, G.J. 1980. Textbook of Engineering Materials. Union Book Stall, M.A Jinnah Road, Karachi.
- Zaman, M.A. 1987. A Textbook of Engineering Materials England.

**ENG-114**

**Functional English**

**2(2 – 0)**

**Area Scope:** The knowledge units in this area collectively encompass the following: Follow English vocabulary and skills to use it in professional life, identify common errors usually made by the learners of English as second language, practice English correctly in speaking and writing.

**Introduction:** public speaking, art of creating a power point presentation, interacting with the opposite gender, classroom etiquettes and teachers' expectations, articles, prepositions, homophones, punctuation, tenses in English grammar, formal letter writing summary writing, organizing and planning your writing, sensory perception in writing, critical thinking, final term project.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

## SEMESTER-III

**BE-201**

**Engineering Mechanics**

**3(2 – 1)**

**Introduction:** 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–FBD:** Vector addition, subtraction and products, resultant of distributed (linear and non-linear) force systems, equilibrium: 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. **Work and Energy:** Work, energy and power impulse and momentum: impulse, momentum, conservation of momentum and energy. **Kinematics of Particles:** Rectilinear and curvilinear motions, tangential and normal components of acceleration, simple harmonic, motion dynamics analysis of components/system.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Singer, F.L. 2000. Engineering Mechanics. Harper and Row Publishers, New York.
- Meriam, J.L. and L.G. Kraige. 1993. Engineering Mechanics. Vol.I Statics. John Willy and Sons, New York.
- Higdon, A., and W.B. Stile. 1986. Statics and Dynamics. Prentice-Hall, Inc. Englewood Cliffs, N. J., USA.
- Riley, W. and Struges, C.d. 1996. Engineering Mechanics, Statics and Dynamites, John Wiley and Sons Inc., New York.
- Bedford, A. and Fowler, W., 1994 Engineering Mechanics: Statics and Dynamics, Addison-Wesley Publishing Company. New York.
- McGill. D.J. and King, W.W., 1994 Engineering Mechanics: Statics and Dynamics, PWS publishing Co., New York

**FPM-203**

**Applied Thermodynamics**

**3(1 – 1)**

**Heating and Expansion of Gases:** Units of heat, gases and vapors, constant volume and constant pressure, P-V diagram, specific heat of gases, the internal energy of gas. **Laws of Perfect Gases:** Law of conservation of energy, methods of heating and expanding gases and vapors, Heating of gases work done by gas in expanding Equations for different types of heating methods. **Laws of Thermodynamics:** Derivation of laws, practical applications of thermodynamics laws. **Air Cycles:** Cycles of operation, air standard efficiency of a cycle, Reversible process, reversible cycles, reversibility and efficiency, Carnot cycle, Otto cycle, diesel cycle. **Entropy of Gases:** Entropy and heat, T-S diagrams, Carnot, Otto, diesel and dual combustion cycles on T-S diagrams. **Air Compressors:** Compressor functions and types, reciprocating and rotary compressors, single and multistage compressors, cylinder clearance, work done, compressor efficiency. **Compound Expansion:** Advantages of compound expansion, tandem type of two-cylinder compound engine, receiver type compound engine; combined indicator diagram for compound engine, calculations for cylinder uniflow engine. **Refrigeration:** Definition and principal coefficient of performance, units of refrigeration, air compression refrigeration, Vapor compression refrigeration, refrigeration cycles, quality of refrigerant and general considerations, heat pumps and components.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Li, K., 2018. Applied thermodynamics: availability method and energy conversion. Routledge.
- Rajpoot, R.K. 2015. Applied Thermodynamics. 2 edition, Jain Book Agency, New Delhi, India
- Nag. 2013. Engineering Thermodynamics. 5 Edition, Jain Book Agency, New Delhi, India.
- Khurmi, R.S. and J.K. Gupta. 2000. Thermal Engineering. S. Chand and Co. Ltd., New Delhi, India.
- Sontag, R.E. and G.J. Van Wylen. 2003. Fundamentals of thermodynamics. 6 Ed, John Willey and Sons, Inc. New York, USA.

**ID-205****Engineering Hydrology****2(1 – 1)**

**Hydrologic Processes:** Introduction, Hydrologic cycle and its components, importance of hydrology, climatic factors, estimation of precipitation, snow-cover and snow fall, stream flow, water stage, discharge, interpretation of stream flow data evaporation and transpiration, Evapotranspiration and its estimate using different methods. **Hydrologic Analysis:** Hydrograph and its characteristics, run off and its components, recessions, hydrograph separation, rainfall-runoff relations, the phenomenon of runoff estimating the volume of storm runoff, estimating snow melt runoff, seasonal and annual runoff relations, hydrograph of runoff, unit hydrograph its derivation and application, overland flow. **Hydrologic Routing:** Introduction, river routing, level pool routing, linear reservoir model, Muskingum method. **Hydrologic Models:** Definition, classification of models, development, calibration, verification, and application of models.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Awan, N.M. 1981. Surface Water Hydrology, National Book Foundation, Islamabad.
- Linsely, R.K., Kohler, J.L.H. Paulhyus 1996. Hydrology for Engineers, SI. Edition, McGraw Hill Kogakusha Ltd.
- Ward, R.C., Robinson, and M. 1990. Principles of Hydrology, McGraw Hill Book Co., London.
- Wilson, E. M. 1990. Engineering Hydrology, Macmillan Civil Engineering Hydraulics. N.Y.

**EE-207****Climate Change and Water****2(1 – 1)**

**General Overview of Climate Change and Global Water Cycle:** Climate variability, drivers of climate change; Observed and future changes in global patterns of precipitation and evaporation; Understanding the water cycle, global water distribution and quantitative and qualitative spatio-temporal changes. **Hydrological Impacts of Climate Change and Variability:** Estimating impacts of climate change on precipitation variability, extreme precipitation events, droughts, floods, evapotranspiration, soil moisture, surface and sub-surface water resources, runoff and river discharge, glacial hydrological regime, fluvial landforms. **Modelling Impacts on Hydrological Systems:** Modelling climate-induced changes in hydrology; Water resource availability and demand, modelling runoff, flood frequency analysis, soil erosion; Socio-economic and environmental impacts; indicators of climate risks to water resources; vulnerability; Factors affecting the vulnerability of water resources. **Mitigation and Adaptation Strategies for water management:** Scale dependent vulnerability-local, regional, global; Vulnerability assessment and adaptation framework – all intra-national governance levels, transboundary water resources; critical knowledge gaps Importance of IWRM for adaptation; Integrated drought management; Potential water resource conflicts, Implications for policy and sustainable development; Risk management

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Bates, B.C., Kundzewicz, Z.W., Wu, S. and Palutikof, J.P., Eds. (2008) Climate Change and Water, Technical Paper of the Intergovernmental Panel on Climate Change VI (IPCC), IPCC Secretariat, Geneva.
- Vörösmarty, C.J., Green, P., Salisbury, J. and Lammers, R.B. 2000. Global water resources: vulnerability from climate change and population growth. *Science*, 289(5477), pp.284-288.
- Xu, J., Grumbine, R.E., Shrestha, A., Eriksson, M., Yang, X., Wang, Y.U.N. and Wilkes, A., 2009. The melting Himalayas: cascading effects of climate change on water, biodiversity, and livelihoods. *Conservation Biology*, 23(3), pp.520-530.
- Immerzeel, W.W., Van Beek, L.P. and Bierkens, M.F., 2010. Climate change will affect the Asian water towers. *Science*, 328(5984), pp.1382-1385.
- Milly, P.C., Betancourt, J., Falkenmark, M., Hirsch, R.M., Kundzewicz, Z.W., Lettenmaier, D.P. and Stouffer, R.J., 2008. Stationarity is dead: Whither water management? *Science*, 319(5863), pp.573-574.
- Arnell, N.W., 1999. Climate change and global water resources. *Global environmental change*, 9, pp. S31-S49.

**FS-209****Strength of Materials****3(2 – 1)**

**Introduction:** Stress and Strains, stress at a point, components of stress, analysis of plane stress, principal stresses, maximum shear stress, Mohr's circle. **Axial loading:** Stress due to axial forces, strain, properties of material under axial loading. **Bending and Torsion:** Bending stresses in beams, shear and bending moment diagrams. **Combined loading:** Stresses due to axial, bending and torsional loading. **Deflection:** Moment-curvature relationship, deflection of beams by the method of double integration. **Deflection of beams:** Double integration method with singularity function, area moment method. **Torsion:** Shearing stress and angle of twist, hollow and circular shafts. **Buckling:** Pin ended column, eccentrically loaded column, initially curved column, critical loads, and critical stresses. **Curved Beams:** stresses in curved bars. **Cylinders and spheres:** Stresses in thin and thick-walled cylinders. **Fatigue loading:** Analysis and design, software applications SAP 2000.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**ENG-211****Communication Skills****2(2 – 0)**

**Writing Skills:** Vocabulary Building, Essays and Letters, Common Writing Errors, Purposeful Writing. **Reading Skills:** Skimming and Scanning, Critical Reading, Reading for Understanding, Techniques and strategies to develop sound vocabulary. **Listening Skills:** Introduction to Communication Process, Seven Cs of Communication, Types of Listening, Listening for Comprehension. **Speaking Skills:** Verbal and Non-Verbal Communication, Basics of Presentation Skills, Presentation Strategies and public speaking skills,

Use of Audio-Visual Aids, Basics of Group Communication, Listening Skills, Communicate effectively in job interviews.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Anchor in English-II (Lessons 1-5), A SPELT Publication
- Christopher Fry, “Summary Writing (Book-I)”, Oxford University Press
- College Essays by John Langland
- Barron’s TOFFL iBT Edition
- Communication Skills for Engineers by Sunita Marshal and C. Muralikrishna

**IS-213**

**Islamic Studies and Ethics**

**2(2 – 0)**

**Islam – Religion of Peace and Harmony:** Basic Concepts – Islam, Quran and Hadith, Faith and Religious Life, Selected Verses of Surah Al-Baqara Related to Faith (Verse No-284- 286), Selected Verses of Surah Al-Mumanoon Related to Characteristics of Faithful (Verse No-1-11). **Islamic Culture and Civilization Basic:** Concepts and of Characteristics of Islamic Culture and Civilization, Education System of Islam, Political System of Islam – Dynamics, Sovereignty and Institutions, Economic System of Islam – Principles, Riba, Trade and Commerce, Acceptance of Other Religions – Interfaith Harmony, Foreign Policy. **Social System of Islam:** Basic Concepts of Social System in Islam, Elements of Family and their Rights - Parents, Women, Husband & Wife, Children Inheritance – Rights and Laws, Social Rights – Neighbors, Relatives and Society, Equality and Brotherhood, Selected Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77), Concept of Welfare State – Period of Khilafat-e-Rashida. **Professional Ethics and Morality:** Basic Concepts - Islam and Ethics, Selected Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154), Profession and Professionalism in Islam, Characteristics of a Professional, Truthfulness, Honesty, Sincerity, Patience, Gratitude, Meditation and Research Role for Human Safety and Environment, Time Management, Prophet Muhammad (PBUH) – Role Model, Selected Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18), Selected Verses of Surah Al-Ihzab Related to Adab Al-Nabi (Verse No. 6, 21, 40, 56, 57, 58). **Islam and Science:** Islam and Science, Role of Muslims in Science and Education, Critical Thinking and Innovation, Selected Verses of Surah Al-Hashar (18,19,20), Related to thinking, Day of Judgment, Selected Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No1,14).

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Al-Qur’ān (القرآن) selected text)
- Sayyid Tāhir Rasūl Qādri دروس قرآن 52 (Karachi: Islamic Research Academy, 7th ed., 2017).
- Sayyid Hasan-uddin Ahmad, 2-vols., 2-تعلیمات قرآنی, (Karachi: Jasarat Publications, 1998).
- Muhammad Shafī‘ (معارف القرآن) Karachi: Dar-ul-Isha’at, 2000)
- Sayyid Abu’l A’lā Mawdūdī, تفہیم القرآن 6vols., (Lahore: Islamic Publications, 1998). [Preambles of all (114) chapters.]
- Amin Ahsan Islahi, (تدبرالقرآن) Lahore: Farān Publications, 2005)
- Khawaja Abdul Waheed, (قرآن موضوعات و انسانی زندگی) Islamabad: Islamic Research Institute, 3rd ed., 1997).



## SEMESTER-IV

**BE-202**

**Differential Equations**

**3(3 – 0)**

**Basic Concepts and Modeling:** Linear Differential equations, Non-Linear, Differential equations, Solutions of differential equations, General solutions, Particular solutions, Initial and boundary value problems, Degree and order of ODEs. **Formulation of first-order ODEs:** Case studies related to finding age of fossils, mixing problems and free fall motion, finding temperature of a building, RL, RC circuits, Airplane take-off problem, Population dynamics and logistic equations etc. **Analytical Methods of Solution for First-order ODEs:** Variable separable method, Reduction to variable separable form, Homogeneous equations, Differential equations reducible to homogeneous form, Solution of the related ODE models by these methods. Exact equations, Integrating factors, Linear equations and related examples, Bernoulli's equations, orthogonal trajectories, and solution of the related ODE models by these methods. **Mathematical Models Based on Second-order ODEs:** Formulation of a single RLC circuit, spring mass systems, Earthquake model of a single-story building, Bungee Jumper model, Bridge collapse problem etc. **Analytical Methods of Solution for Second-order ODEs:** Homogeneous linear ODEs, Method of reduction order, Wronskain determinant to check independence of the solution, and related examples, Cauchy-Euler equations and related examples, non-homogeneous linear ODEs, Method of undetermined coefficients, Method of variation of parameters and related example, Analytical solution of the related ODE models by these methods. **Series Solution for Second-order ODEs:** Series solution of ODEs and convergence tests, Series solution of Legendre equation, Frobenius method of solution for Bessel equation and related applications. **Laplace Transform:** Laplace Transform, Derivation of Basic formulae, Inverse Laplace Transform, First shift theorem, Laplace transform of integrals and derivative, Solution of second order ODEs by Laplace Transform, Unit step function and its Laplace transform, second shift theorem, Convolution Application of Laplace transform to a system of ODEs and related applications. **Partial Differential Equations:** Partial Differential Equations and their types, Applications of partial, differential equations in Engineering Method of Separation of Variables Method (MSVM) and solution of wave equation by the MSVM Method of Separation of Variables Method (MSVM) and solution of heat equation by the MSVM

### **Teaching Methodology (Proposed as applicable):**

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

### **Assessment**

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

### **Suggested Books:**

- Advanced Engineering Mathematics by Erwin Kreyzig, John Wiley & Sons Inc. Latest Edition.
- Differential Equation with Boundary Value problems by D. G. Zill, M. R Cullen Latest Edition, Brooks/Cole Publishers.
- A First Course on Differential Equations with Modelling Applications by D. G. Zill, Latest Edition, Brooks/Cole Publishers.
- An Introduction to Mathematical Modelling by Bender, E.A., Latest Edition, Wiley, New York.

**FPM-204**

**IC Engines and Tractors**

**3(2 – 1)**

**Introduction:** History of engine development, engine cycles, Principles of operation, types of engines. **Principal Parts of Engine:** Functions and construction, Working mechanism. **Fuels and Combustion:** Types and properties of engine fuels, Fuel tests and their significance, gasoline tests, antiknock test, Engine emissions and their analysis. **Fuel System:** Major components of fuel systems (petrol/diesel), Fuel classification and storage, Theory and mechanism carburetor, Fuel injection pump, injector/nozzles, electronic fuel injection, Governing system, calibration of fuel injection pump, Trouble shooting of fuel

system. **Ignition System:** Types of ignitions, spark, magneto and compression ignition system, Induction coils, distributor, spark plug, contact-breaker points, condenser, Trouble shooting. **Cooling System:** Types, principle of operation, parts of air/water cooling system, line diagram, Radiator, thermostat, water pump, fan, engine heating, types of coolants, Repair, and maintenance. **Lubrication System:** Types of lubrication systems principle of operation, Components of lubrication systems, line diagram, Types of lubricants, trouble shootings and maintenance. **Electrical System:** A.C. and D.C. voltage, alternator/dynamo, Battery, battery charging and maintenance, Self-starter, electrical gauges and controls, line diagram, Repair and maintenance of electrical system. **Intake and Exhaust System:** Air intake system, valve timing diagram, Air cleaner, super charger, turbo charger, inter-cooling, Construction of intake and exhaust manifolds, mufflers, flue gases. **Mechanics of the Farm Tractor Chassis:** Kinematics and dynamics of tractor power applications, Force Analysis, Soil reaction, Drawbar pull and traction mechanism, Stability of tractors, Tipping and lateral stability. **Power Transmission System:** Clutch and Brakes, Transmission, Differentials, Power take-off, Pulley drives, Power lift and hydraulic controls, Tractors tests and performance

#### **Teaching Methodology (Proposed as applicable):**

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

#### **Assessment:**

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

#### **Suggested Books:**

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

**ID-206**

**Fluid Mechanics**

**3(2 – 1)**

**Introduction:** Definition and branches of fluid mechanics, Distinction between solid and fluids. **Properties of Fluids:** Density, viscosity, surface tension, specific weight, specific gravity, etc., Bulk modulus of elasticity, compressibility of fluids. **Fluid Statics:** Pressure variations in fluid, pressure measuring devices, gauges and manometers, Buoyancy and stability of submerged and floating bodies, Forces on plane and curved surfaces, center of pressure. **Fluid Kinematics:** Continuity Equation, Types of flow, dimensions of flow, streamlines, path lines, Flow patterns for different references, continuity equation, Source flow, sink flow, flow nets, uses and limitations of flow net. **Fluid Flow Measurements:** Orifices, weirs, notches and venturi meter, Pitot tube, coefficient of contraction, Velocity and discharge, derivation of their discharge formulae, Calibration and their applications. **Energy Consideration in Steady Flow:** General equations of steady flow, heads, Bernoulli's equation and its practical applications, Hydraulic and energy grade lines, power consideration in fluid flow, Cavitation, head losses, solution of flow problems. **Momentum and Forces in Fluid Flow:** Impulse-momentum principle and application, Force exerted on stationary and moving bodies (flat and curved), Relation between absolute and relative velocities, reaction of jet, jet propulsion. **Similitude and Dimensional Analysis:** Geometric, kinematic, dynamic similarity, Dimensionless numbers like Reynold Number, Froude number etc., and their application, **Steady Incompressible Flow in Pressure Conduits:** Laminar and turbulent flow in circular pipes, Major and minor energy losses in pipes, Branching pipes, pipes in series, pipes in parallel and pipe network analysis Turbines: Types of turbines, suitability of turbines, Components of turbines.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Cengel, Y.A., and J. Cimbala, 2013. Fluid Mechanics Fundamentals and Applications, 3<sup>rd</sup> Edition, ISBN-13: 978-0073380322
- Frank White, 2016. Fluid Mechanics, 8th edition, McGraw-Hill Series
- Franzini, J.B., and E.J. Finnemore. 2001. Fluid Mechanics with Engineering Application, 10th Edition, McGraw Hill Book Co. Singapore.
- Jain, A.K. 1990. Fluid Mechanics: A Textbook for Engineering Students.
- Khana Publishers, New Delhi, India. Streeter, V.L. 1988. Fluid Mechanics. McGraw Hill Inc., New York.

**LWM-208****GIS & Remote Sensing****2(1 – 1)**

**Introduction to GIS:** Backgrounds and basic concept, Scope and application area, Mapping concept, Map types, Map elements and scales, Mapping process. **Fundamentals of GIS:** Types of datasets, Formats of datasets, Functional elements of GIS, Spatial data models, Raster and vector data structures, Inter-conversion of raster and vector data structures. **Introduction to Remote Sensing:** Concept of RS technology, RS data types, Satellite systems and sensors, GPS and DGPS, Spectral signatures. **Spatial and Attribute Database Development:** Data query, Attribute data handling, Vector data-based development, Vectorization process, Flat file description, Spatial and attribute data linking, Database management. **Data Manipulation and Analysis:** Soil Geo-processing Techniques, Interpolation using geo-statistics, Reclassification technique, creating continuous surfaces from point data, global methods, Creating continuous surfaces from point data, local methods, Pixel sampling & Quantization. **Introduction to Remote Sensing Image:** Image interpretation process (elements and strategies), Image processing techniques (data import, Geometric correction), Image interpretation & GPS technique: Visual and digital interpretation Global Positioning System (GPS) technique and process, Image classification: Hybrid technique of image classification, Supervised and unsupervised techniques. **Remote Sensing Analysis:** Land cover/Land use classification and monitoring, Ground truthing and field verification, Integration of RS and GIS techniques, Land cover change detection, Digital Elevation Model (DEM) techniques, Topographic feature extraction and application, Digital Elevation Model utilization in watershed / Basin modeling, Integration of DEM in GIS (Visualization and Mapping). **Natural Resources Management using Satellite Imagery:** Introduction to remotely sensed crop, soil, land and water information, Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI), Normalized Difference Built-up Index (NDBI), Normalized Difference Snow Index (NDSI), Moisture Stress Index (MSI), Relationships between radiations and earth features, Time series crop health monitoring using vegetation indices.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Barrett, E.C. and Curtis, L.F. 2014. Introduction to Environmental Remote Sensing, 4th Edition, Chapman and Hall, London.
- Foody, G. and Gurrán, P. 1994. Environmental Remote Sensing from Regional to Global Scales. John Wiley and Sons, England.

- Heywood, I., Cornelius, S., and S. Carver 2012. An introduction to geographical information systems, 4th Edition, Illustrated Published by Pearson Prentice Hall.
- Keith, C.C., Bradley O. Parts and Michael P.C. 2004. Geographic Information Systems and Environmental Modeling.
- McCoy, R. M., 2005. Field methods in remote sensing, Published by Guilford Press, ISBN 1593850794, 9781593850791 Manual of Remote Sensing
- Paul Bolstad, 2012. GIS Fundamentals: A First Text on Geographic Information Systems, Fourth Edition, Eider Press White Bear Lake, Minnesota.
- Patel. A. N. 2012. Remote Sensing: Principles and Applications (2<sup>nd</sup> Ed.). Scientific Publishers, Jodhpur, India

## EE-210

## Environmental Engineering

3(2 – 1)

**Introduction:** Basics definition of environment, Pollutants and their classification, Environmental Regulation and standards, EPA Act, NEQS, WHO Standards. **Water Environment:** Water/Wastewater Pollutants, Water Quality Standards, Agriculture and Water Environment Pollution, Dissolved Oxygen Sag, River Water Quality Management, Unit operations/processes for Pre-treatment, Preliminary, Primary, Secondary and Tertiary Treatments. **Solid Waste:** Agricultural and Municipal Solid Wastes (SW) Management; SW Categories, Composition and Characteristics (Physical, Chemical, Biological), 4R Integrated SW Management- Reduce, Recover, Reuse & Recycle, Physical, Chemical and Bio Processing of SW, Composting, Incineration, Landfilling, other techniques for safe disposal and reuse of SW. **Soil Contamination:** Soil Degradation and Soil, Biological Indicators of Soil Quality – Soil Respiration Rates, Physical Indicators of Soil Quality, Chemical Indicators of Soil Quality, Physical Soil Degradation, Soil Erosion, Soil Compaction, Soil Crusting and Sealing, Chemical Soil Degradation, Acidification, Salinization and Sodification, Major Types of Soil Pollutants, Heavy Metals and Their Salts, Heavy Metals and the Soil System, Transport of Heavy Metals within the Soil System, Bioavailability of Heavy Metals, Biochemical Effects of Heavy Metals, Major Environmental Accidents Involving Pollution by Heavy Metals, Other Inorganic Pollutants, Radionuclides, Speciation and Behavior of Radionuclides in the Soil System, Uptake of Radionuclides by Plants, Nuclear Debris from Weapon Tests and Belligerent Activities, Nuclear Debris from Major Nuclear Accidents (please reduce) Air Pollution: Smog, smoke, dust etc., environment system analysis. **Monitoring and Assessment:** IEE and EIA, Instrumentation, Report formats

### Teaching Methodology (Proposed as applicable):

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

### Assessment:

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

### Suggested Books:

- Davis, Mackenzie. Masten, Susan. 2004. Principles of Environmental Engineering and Science, McGraw Hill International NY USA
- Mckenzie L. David A. Cornwell 1991. A textbook of “Introduction to Environmental Engg”
- Ibrahim A. M. (2008). Soil Pollution: Origin, Monitoring and Remediation, 2nd Edition, Springer-Verlag Berlin Heidelberg
- Basak, N. N. 2003. Environmental Engineering
- Kumar, A. 2004. Industrial Pollution and Management
- Neelima R. and D.K. Markandey. 2005. Environmental Analysis and Instrumentation
- Vesilind, P.A. J.J. Peirce and R.T. Weiner. 1990. Environmental Pollution and Control Butterworth-Heinemann, London
- Techo benoglous, G. Hilary Theisen and Samuel Vigil, 1995, Integrated Solid Waste Management, McGraw Hill International NY
- Khan, I.H. and Ahsan, N. 2003. Textbook of Solid Waste Management. CBS Publishers & Distributors, Darya Ganj N Delhi. 110002 India.

- Shuller, M. L. 1980. The Utilization and Recycle of Agricultural Wastes and Residues. CRC Press Inc. 2000 Corporate Blvd. N.W. Boca Raton Florida USA

SE-212

Social Sci Elective-I (Sociology for Engineers)

2(2 – 0)

**Fundamental Concepts and Importance of Sociology for Engineers:** What is sociology? Nature, Scope, and Importance of Sociology, Sociological Perspectives and Theories, Social Interactions, Social Groups/ Social Institutions & their interface with Engineering Project/services, Sociology & Impact of Technology & Engineering Products/Projects on Society. **Cultural Impacts of Engineering Projects on Society:** Definition of Culture, Types of Culture & Elements of Culture, Culture & Power, Authority, Dominance Socialization and Personality, Role of Engineering Projects on Culture, social norms and values of Society, Cultural Infusion of Engineers in Society. **Theoretical Perspective of Sociology: Diffusion and Innovation; Adoption and Adaptation; Social development:** Community Development Community Development & Social consequences of Industrialization, Development Processes of Societal Development, Cooperation and Conflict in Community Development in Engineering Context. **Understanding of Societal & Ethical Norms and Values for Engineers:** Engineering Ethics, Engineering product/services for less privileged, Role of Engg & Technology in addressing Social inequality, Core Social Values/Norms affecting Engg Performance **Organizational Social Responsibility (OSR) of Engineers:** Extent to which development in tends to sensitize societal and under-privileged, needs Gender inclusiveness and balance, Special and Disadvantaged Community of the Area, Planning for community inclusiveness, Societal Obligation of Engineers. **Engineers, Society and Sustainability:** Social System and Concept of Sustainable Development Technology and Development, Population Dynamics in Pakistan, Causes and Consequences of Unplanned Urbanization, Community Development, Programs in Pakistan, Community Organization & Engineering Projects, Population, Technological & Industrial expansion and Development with focus on social/human/ethical dimensions. **Industrial & Organizational Psychology:** Interpersonal Relations, Interpersonal Behavior, Formation of Personal Attitudes, Language and Communication, Motivations and Emotions, Impact of Technology on human feelings and level of Sensitivity. **Climate Change and Ecological Friendliness from Engineering Perspective:** Ecological Processes, Ecosystem and Energy, Impact of Engineering Projects on Eco System & Human Ecology, Industrial & Environmental impact on Population & General Masses, Technological Intervention, Ecosystem and Physical. Environment, **Social Impact of Technology & Engineering Products & Services (Solid Waste Disposal, Pollution control etc.). Social Approaches and Methodologies for Development Administration & Stakeholders Analysis:** All Phases of the Project (pre, post and execution) Structured, Focused Group, Stakeholder Consultative Dialogues etc. Dynamics of Social Change, Sociology of Change and Industrial Development, Social Change due to Technology Driven Economic Growth. **SIA (Social Impact Assessment):** Base line and need-assessment, evaluation and impact assessment surveys of the development projects. Role of Engg & Technology for Creating Social Cohesiveness & Societal Integration. Technology Based change in Collective Behavior, Social Audit of Engineering Projects. **Engineering Intervention for Social Stratification:** Factors of Social Stratification, Engineering Interventions for addressing Social Stratification, Social Mobilization through Technological Innovation. Case Studies of Different Development Projects in Social Context

**Teaching Methodology (Proposed as applicable):**

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg. disciplines, Semester Project, Guest Speaker, Project / Field Visits, Group discussion, Community Service, Report Writing, Social Impact Review and Social Audit of Engg Project

**Assessment:**

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

**Suggested Books:**

- Godhade, J. B., and S.T. Hunderkari. 2018. Social Responsibility of Engineers. International Journal of Academic Research and Development. Vol. 03; Special Issue. March, 2018.
- Nichols, S.P. and Weldon, W.F.2017. Professional Responsibility: The Role of Engineering in Society Center for Electro-mechanics, The University of Texas at Austin, USA.

- Aslaksen, E.W. 2016. The Relationship between Engineers and Society: is it currently fulfilling its potential? Journal and Proceedings of the Royal Society of New South Wales, Vol. 148. Nos. 455-456. Gumbooya Pty Ltd, Allambie Heights, Australia.
- Bell, S. Engineers, Society and Sustainability. Synthesis Lectures on Engineers, Technology, and Society. Edited by Caroline Baillie, University of Western Australia. Morgan and Claypool Publishers
- Jamison, A., Christensen, S. H., and Lars, B. 2011. A Hybrid Imagination: Science and Technology in Cultural Perspective.
- Vermaas, P., Kroes, P., Poet, I., and Houkes, W. 2011. A Philosophy of Technology: From Technical Artefacts to Socio technical systems.
- Mitcham, C., and Munoz, D. 2010. Humanitarian Engineering. Morgan and Claypool Publishers. Riley, D. 2008.
- Engineering and Social Justice. Morgan and Claypool Publishers. Bugliarello, G.1991. The Social Functions of Engineering: A Current Assessment, a Chapter in “Engineering as a Social Enterprise.

## IT-214

## Artificial Intelligence (AI)

2(1 – 1)

**Introduction:** Overview of AI Problems; Intelligent Behavior: Turing Test, Rationale versus Non-rationale Reasoning. **Problem Characteristics:** Fully versus Partially Observable, Single versus Multi agent. **Intelligent Agents:** Reactive, deliberative, goal-driven, utility-driven, and learning agents; Uninformed Search: Depth First, Breadth First, Depth First with Iterative Deepening; Informed Search: Hill climbing, A\*- Search and their Time and Space Complexity, Local Search, Genetic Algorithm; Game Playing: Minimax, Evaluation functions, Alpha-beta pruning; Propositional and Predicate Logic; Resolution and Theorem Proving; Forward and Backward Chaining. **Machine Learning:** Introduction, Supervised learning: Instance based learning, Decision tree, artificial neural networks, Unsupervised Learning: K-means Clustering, Reinforcement Learning.

### Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. Disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

### Assessment:

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

### Suggested Books:

- Stuart J. Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, latest Edition, Prentice Hall, ISBN-13: 978-0136042594.
- Elaine Rich and Kevin Knight, “Artificial Intelligence”, latest Edition, McGraw-Hill, ISBN-13: 978-0070522633.
- R. J. Schalkoff, “Artificial Intelligence in Engineering Approach”, latest edition, McGraw Hill, ISBN-13: 978-0070550841.
- Peter Jackson, “Introduction to Expert Systems”, latest Edition, Addison Wesley, ISBN-13: 978-0201876864.
- Ivan Bratko, “Prolog Programming for Artificial Intelligence”, latest Edition, Addison Wesley, ISBN-13: 978-0321417466

## SEMESTER-V

**BE-301**

**Numerical Analysis**

**2(2 – 0)**

**Error Analysis and Interpolation:** Error analysis, Types of error, Sources of error, Norms of vectors and matrices, Computer arithmetic, Condition number of a matrix, Significant digits and loss of significant digits, Floating point arithmetic, Binary and decimal representation, Single and double precision. **Interpolation:** Newton forward and backward difference formula for interpolation, Central difference interpolation formulae, Lagrange's interpolation, Error in interpolation, Linear least square approximation, Interpolation versus least square approximation, Relevant engineering case studies. **Numerical Differentiation and Integration:** Derivation of numerical differentiation of first order and second order derivatives using two points, three points, and five point's formulas along with its application in engineering, relevant case studies. **Numerical integration:** Trapezoidal rule, Simpson's rules, Composite Trapezoidal Simpson Rules and Romberg integration, Applications of numerical in engineering, relevant case studies **Methods of Solution a System of Linear Equations** Solution of system of linear algebraic equations, Gauss elimination method LU factorization, Tridiagonal solver Applications of these methods in engineering disciplines, relevant case studies. **Iterative Methods for Linear and Nonlinear Equations:** Numerical Solution of nonlinear equations: Bisection method, Newton's method, Secant method, Convergence analysis of these methods Newton's method for system of nonlinear equations, Solution of system of linear equations by Jacobi, Gauss Seidel and SOR methods, Applications of these methods in engineering disciplines, relevant case studies. **Numerical Methods for IVPs and BVPs:** Euler's method and its variations, Taylor's higher order methods, Error analysis, Consistency, stability, and convergence Runge-Kutta methods of order 2, 3, and 4, Stiff ODEs, Consistency, stability and convergence Linear multistep methods, Numerical solution of system of ODEs, Numerical solution of BVPs by Finite Difference Method. **Applications in engineering:** Some relevant case studies. Numerical Methods for Computing Eigenvalues Eigen values and Eigenvectors of matrix: power method, Inverse power method, Shifted inverse power method. Applications of eigenvalues in engineering disciplines. Numerical Optimization Unconstrained Optimization, Golden search ratio, Lagrange Multipliers, Method of steepest descent, Applications of optimization in engineering disciplines.

### **Teaching Methodology (Proposed as applicable):**

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

### **Assessment**

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

### **Suggested Books:**

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

**FPM-303**

**Machine Design**

**3(2 – 1)**

**Introduction:** Mechanical Engineering Design, Safety, and product reliability. **Design Considerations:** Phases of design, Codes and standards, evaluation, and presentation. **Design of Shafts:** Design of shafts, torsion of circular shafts, Horsepower transmitted by the shafts. **Design of Clutches:** Design procedure, Numerical problems. **Design of Bearings:** Design procedure, Numerical problems. **Design of Gears:** Design procedure, Numerical problems. **Design of Flange:** Design procedure, Numerical problems. **Design of Couplings:** Design procedure, Numerical problems. **Design of Pulleys:** Design procedure, Numerical problems. **Design of Connecting Rods:** Design procedure, Numerical problems. **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.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**ID-305****Open Channel Hydraulics****3(2 – 1)**

**Basic Concepts of Free Flow:** Types, state and regimes of flow, Channel flow types (steady, unsteady, uniform, and non-uniform, mixed flow), Channel geometry. **Energy and Momentum Principle:** Basic equations, 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. **Velocity Measurement in Channel:** Velocity distribution in channel and its coefficients, Pressure distribution in channel, Effect of slope on pressure distribution. **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, Determination of section dimensions. Best hydraulic section. **Rapidly Varied/ Turbulent Flow:** Characteristics of varied flow, Types of weirs, sharp crested weir and board crested weir, Aeration of the nappe crest shape, Discharge over spillway, Type of the hydraulic jump, Characteristics of the hydraulic jump, Jump as energy dissipater, Flow through sudden transitions.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**LWM-307****Soil Mechanics****3(2 – 1)**

**Soil Formation:** Soil and its Constituents, Weathering of Rocks and Types of Soils, Description, and identification of soil (Visual-Manual Procedure), Mineralogy of Solids. **Physical Properties:** Water Content, Void Ratio, Porosity, Degree of Saturation, Specific Gravity, Unit Weight, and their determination, Atterberg's limits. **Classification of Soils:** Sieve Analysis, Hydrometer and Pipette Analysis, Stoke's Law, Grain Size distribution. **Grain Size Classification:** Bureau of Soils, M.I.T. Unified, AASHTO and ASTM Classification systems. Textural Classification by Triangular Chart, Unified Soil Classification, AASHTO Soil Classifications. **Soil Stability Analysis:** Retaining Walls, Definition, purpose and classification, Forces acting on earth retaining structures, Lateral earth pressure. **Compaction:** Purpose and theory of Compaction, Moisture Content and Dry Density relationship, Standard Proctor Compaction Test, Modified Proctor Compaction Test, Degree of Compaction, and its determination in the Field Methods of compaction in the



field; Factors affecting compaction of soils. **Soil Permeability and Seepage:** Darcy's law, Hydraulic conductivity, Laboratory determination of Hydraulic Conductivity, Directional variation of permeability, Equivalence hydraulic conductivity, Continuity equation for solution of simple flow problems, Flow nets and seepage calculation from flow net, Seepage through and earthen dam on an impervious base. **Vertical Stresses in Soils:** Definition, Stresses caused by self-weight of soil, Geostatic stresses, stresses caused by Point Loads and Uniformly. **Distributed Loads:** Boussineq and Westergarrd theories, Pressure bulb, Stress distribution diagram on horizontal and vertical, Stress at a point outside loaded area, Newmark's charts and 2:1 Method. **Bearing Capacity of Soil:** Definition of bearing capacity, Factors affecting bearing capacity, Classification of foundations, Stability requirements of a foundation. **Soil Exploration:** Importance of Soil Exploration, Soil Exploration methods, Probing, Test Trenches and Pits, Auger boring, wash boring, rotary boring, dewatering, Percussion drilling and Geophysical methods, Sol Samples, Disturbed and Un-disturbed samples, In-situ Tests (SPT, CPT and PLT).

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**FS-309**

**Rural Electrification**

**2(1 – 1)**

**Type of Electricity Production** (Solar, Biogas, Biomass, Hydel, Wind, Fossil Fuels): Benefits of Electricity in Agriculture: elementary transmissions and distribution, transformation voltage; basic principles, ratio of transformation, iron and copper losses; regulation, auto-transformers, 3- phase transformers, delta star connections, scot connection, constructional features and cooling of transformers. **Electrical Wiring Practices:** farmstead and farmhouses. **Radiation:** types of radiation and application in agriculture; Resistance heating: unit's advantages and applications. **Sensing Elements and Fundamentals of Control:** Response to environmental factor like temperature, pressure, humidity, radiation etc. **Selection of Motors:** single and three phase; Selection of electrical wires and distribution types; Electrical wiring, electrical distribution systems, electrical panel boards, one-way and two-way wirings/connections, single phase and three phase connections. **Electricity Fundamentals:** Nature of electric current, resistance and voltage, effect of temperature on resistance, specific resistance, Ohm's Law, units of power, arrangements of resistor in series and parallel, Kirchoff's Laws. **Electric Machines:** DC Machines: DC generator, working principle, construction, and types. DC motors, working principle, construction, and types. **AC Machines:** AC generators (Alternators), working principle and construction. AC motors operating principles, single and three phase motors, various types of motors. **Transformers:** Working principle, construction, and types. EMF equation, ratio of transformation. Electric Instruments: Introduction to electric instruments, types and application of different electric instruments (Potentio-meter, strain gauges, electric transducers). **Farmstead Distribution System:** Electric load, types of distribution centers, locating the distribution center, selection of wire for feeder lines. Electricity for Water Supply and Cooling: Horsepower required for pumping, wiring devices and control, energy cost of water system, refrigeration cycle and refrigeration Control, calculating the product load and space load. **Electricity for Heating:** Advantages and disadvantages of electric heating, electric heating elements, electric heating equipment, under heat brooders, infrared brooders, and electric hot bed. **Electrical Control and Special Equipment:** Switches, relays, push buttons, thermostats, time switches, floating switches, pressure switches, milk cooler, electric fences, and feed processing equipment.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Farm electrical equipment handbook. 1950. Electrical institute. New York City USA.
- Hienton, T. 1958. Electricity in agricultural engineering. John Willey and Sons. N.Y USA.
- Bhagat, R. P. 1993. Rural Electrification and Development, ISBN: 8171004997 Deep and Deep Publications Pvt. Ltd. India.
- Theraja, B. L. (2000). A Textbook of Electrical Technology, 21st Ed., Publication Division of Nirja Const. and Development Co., Pvt. Ltd., Ram Nagar-India.
- Golding, E.W. and F.C. Widdis. (1990). Electric Measurements and measuring instruments, 5th edition. The English Language Book Society and Pitman Publishers.
- Brown, R. H. (1956). Farm Electrification. McGraw Hill Book Co. New York.
- Gustafson. (1980). Fundamental of Electricity for Agriculture. Van Nostraud Co.

**EC-311****Management Elective-I (Entrepreneurship)****2(1 – 1)**

**Introduction:** Basic Concept-Entrepreneurship, Innovation and Entrepreneurship, Basic Plan Development Cycle. **Intellectual Rights:** Financial and Legal Modalities, Marketing, Industrial Competiveness, Gap Analysis, Critical Thinking and Idea Generation, Business Plan Development, Successful Case Studies (local).

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**STAT-313****Probability and Statistics****3(3 – 0)**

**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, Simple & Multiple Bar diagrams. **Measure of Central Tendency:** Arithmetic Mean (A.M), Geometric Mean (G.M), Harmonic Mean (H.M), Quantiles (Median, Quartiles, Deciles,

Percentiles), Mode, Applications of Averages. **Measure of Dispersion:** Background, Range, Quartile deviation, Mean deviation, Variance, Standard deviation, Coefficient of variation, Moments, Moments ratios, Skewness, Kurtosis Applications in different Engineering Disciplines. **Simple Regression, Correlation and Curve Fitting:** Introduction to regression theory, Simple linear regression line, Line fitting by least square methods, Coefficient of determination, Simple correlation, coefficient of correlation, fitting of a first- and second-degree curve, fitting of exponential and logarithmic Curves, related problems. Principle of least squares. **Probability and Random Variables:** Probability review, Laws of probability, Conditional probability, Bayesian theorem, independent, dependent events. Random variables, Discrete and Continuous random variables, Probability mass and density functions, Distribution functions, Mathematical expectation, Variance of random variable, Bivariate distribution, Joint probability distribution, Moment generating function. **Probability Distributions:** Discrete distributions, Bernoulli distribution, Binomial, Geometric, Negative binomial, Hypergeometric, Poisson distribution, Properties and application of these distributions. Continuous Distributions: Uniform Distribution, Exponential distribution, Normal distribution, Applications. **Sampling and Sampling Distributions:** Introduction, Population, Parameter & Statistic, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors, Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem. Applications in relevant engineering discipline **Statistical Inference and Testing of Hypothesis:** Introduction to inferential statistics, Estimation, hypothesis testing of population mean, proportion, Variance, Applications in Engineering.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Introduction to Statistical theory part 1, by Sher Muhammad Chuadary (Latest Edition)
- Advanced Engineering Mathematics, by Erwin Kreyszig (Latest Edition)
- Probability and Statistics for Engineers and Scientists, by Antony Hayter.
- Elementary Statistics, by Bluman.

## SEMESTER-VI

**FPM-302**

**Farm Machinery and Automation**

**3(2 – 1)**

**Mechanization:** History of mechanization, Objectives, constraints, and policy measure. **Equipment for Sowing and Planting:** Functions, components and types of planting equipment, Seed metering devices, maize drills, Calibration of seed drill. Broadcasting machines, Transplanting machines, Sugar cane planter etc. **Equipment for plant protection (5 hours):** Chemical plant protection, Mechanical plant protection, Dry chemical application equipment, Liquid chemical application equipment, Boom sprayer parts and working, Calibration of boom sprayer, nozzles and their types, precision sprayers. **Grain and seed harvesting (8 hours):** Harvesting methods, reaper, mower, sugar cane harvester, cotton picker, corn/maize harvester, thresher, Types of threshing cylinders, threshing effectiveness, cylinder adjustment, Types and development of combines, functional elements of a combine, flow path of material, Types and sources of seed loss, Testing of combines and its power requirements. **Field capacities and cost analysis (3 hours):** Field capacity, factors affecting field capacity, thorough put capacity, Cost analysis, fixed cost, and variable cost. **Precision agriculture equipment (8 hours):** Introduction and utilization of direct rice drill, Rice trans-planter, Pneumatic seed drill, narrow seed drill. Precision planters: Thematic mapper for soil analysis, Variable rate sprayer, Drones usage in precision agriculture, Auto-steering technology.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**FPM-304**

**Instrumentation and Control**

**2(1 – 1)**

**Introduction:** Basic terminologies, concepts related to instruments, Instrument behavior application of instrumentation. **Functional Elements of Instruments:** Error of instrument, uncertainty analysis, Least square techniques, static and dynamic characteristics of instrumentation, signal conditioning and recording devices. **Principles and Theory of Electrical Instruments:** Potentiometer, wheat stone bridge, Strain analysis; strain measurement; strain gauges, types and their applications. **Displacement, Velocity and Acceleration Measurement:** Sensors and transducers, displacement measurement sensors; potentiometer, LVDT, capacitance sensors, piezoelectric sensors, Velocity and acceleration sensors Force and Torque. **Force Measurements:** Load cells, Torque measurements, Torque cells. **Pressure Measurement:** Gauge, vacuum and absolute pressure, pressure measuring devices. Measurement of Temperature: Resistance thermometer, Thermocouples, and radiation methods. **Fundamentals of Mechatronics:** Introduction to electronics and sensors used in agricultural machinery, Interfacing the machine and computers for response, Controls and data logging, computer simulation of mechanical system.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**ID-306****Pumps and Tubewells****2(1 – 1)**

**Introduction:** Functions of pumps and tubewells, Importance of pumps and tube wells in irrigation and drainage, Groundwater exploitation by tube wells Formulation. **Well Hydraulics:** Flow through porous media, Darcy's law, Aquifers and its types, Flow in confined and un-confined aquifers, Wells near aquifer boundaries, Multiple well system, Specific capacity, Well losses, Well efficiency, Aquifer testing. **Description of Tube Wells:** Components of a tube well, Factors affecting selection of site, Well drilling methods (percussion boring, straight and reverse rotary rigs), Well design, Well development methods, Skimming wells, Scavengers Wells. **Pumps:** Pump components, Pump classification; centrifugal, jet, positive displacement, turbine, pumps, submersible pumps, propeller and mixed flow pumps and air lift pumps- Types of impellers. Terminology in pumping systems- specific speed, priming, pumping, energy, total dynamic head, pump problems and their remedies. Power requirement of pump. **Characteristics of Pump:** Specific speed, TDH-Q, BP-Q, NPSH-Q and Efficiency-Q curves, Cavitation, Net positive suction head (NPSH), Affinity laws, Pump testing, Maintenance of pumps, Pump System Design and Power Requirements, Suction lift, Delivery head, Friction head loss, Operating head-seasonal-variation in system head curve, Pump selection, Feasibility of prime mover selection.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Ahmad, N. 1995. Tube Well Theory and Practices, Shahzad Nazir Publisher, Gulberg-III, Lahore.
- Colt Industries 1979. Hydraulic Handbook, 3601 Fairbank Avenue, Kanasa City, Kansas 661100, USA.
- Hunt, T., and N. Vaughan, 1997. Hydraulic Handbook, 9thEdition, Elsevier Science.
- Sterrett, R.J., 2007. Groundwater and Wells, Smyth Co. Inc., USA.

**EE-308****MDE Elective-I (Wastewater Engineering)****3(2 – 1)**

**Water Quality:** Definitions and Terminology, Water Quality Indicators, key terms and Objectives, Conventional and Emerging Water Pollutants and their Sources Drinking, Irrigation and Industrial Water Standards and Regulations (PEPA and WHO) Water Quality Status, Conveyance and Distribution Issues in Pakistan. **Water Characteristics and Science:** Physical: Solids, Turbidity, Color, Taste and Odor, Temperature Chemical: pH, Total Dissolved Solids, Alkalinity, Hardness, Fluoride, Metals, Nutrients Biological: Bacteria, Viruses, Protozoa and other pathogens indicators, Concepts of Water Cycle, Chemistry and Microbiology. **Water Treatment Unit Operations and Processes:** Screening, Aeration, Sedimentation, Chemical Addition, Rapid and Slow Mixing, Flocculation, Filtration Coagulation, Neutralization, Disinfection, Fluoridation, Water Softening, Turbidity Removal, Re-carbonation, Disinfection, Taste and Odor Control, Direct Filtration and Softening Water Treatment Plants. **Advanced Water Treatment Processes:** Ion Exchange, Ozonation, Adsorption, Ultra Filtration Membrane Processes, UV and Ozone Disinfection. **Wastewater Characteristics and Treatment:** Physical: Total Solids and

Fractions (Suspended, Dissolved, Volatile and Fixed), Color, Temperature and Odor Chemical: pH, Dissolved Solids, COD and Fractions (particulate and dissolved), Alkalinity, Nutrients, Inorganics including Metals Biological: Biodegradable Organics, BOD fractions, microbial and pathogens indicators Terminologies and Definitions, Goals and levels of Wastewater Treatment, Wastewater Treatment Regulations and Standards. **Wastewater Collection and Treatment Processes:** Sewerage and Wastewater Collections Systems Physical Unit Operations, Chemical and Biological Unit Processes **Preliminary Treatment:** Screening, Shredding, Grit Removal, Pre-aeration, Equalization Sampling and Preliminary Treatment Process Control Primary Wastewater Treatment (WWT) Sedimentation Process and Types of Sedimentation Tanks Clarifier loading and Process control, TSS and BOD Removal Performance, sludge pumping High rate and Chemically Enhanced Primary Treatment. **Secondary Biological WWT:** Microorganisms and their role in wastewater treatment Types of biological processes for wastewater treatment. Secondary Treatment Terminology and Process equipment, Bacterial Growth kinetics (Monod equation) and Process Modelling. **Suspended and Attached Growth Biological Treatment Systems (Aerobic & Anaerobic):** Aerated Lagoons, Stabilization Ponds and Oxidation Ditches, Activated Sludge Process, Factors affecting, Modifications and Process Control Sequencing Batch Reactors (SBR) and up flow Anaerobic Sludge Blanket (UASB), Trickling Filters and Packed-bed Reactors Secondary Clarification and Plant Performance. **Advanced Treatment Systems:** Chlorine Disinfection, Ozonation and UV irradiation. Chemical Treatment, Micro-screening, Filtration, Biological Nutrients Removal, Land Treatment, and other options. **Sludge Treatment and Disposal:** Sludge Thickening and Conditioning Sludge Stabilization (Aerobic and Anaerobic Digestion) and Dewatering

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**FS-310**

**Engg. Elective-I (Landscape Engineering)**

**2(1 – 1)**

Introduction: importance of landscaping, gardening and its design, Principles and elements of landscape design, landscape design materials, Types of designs; formal and informal garden designs, Chinese and Japanese gardening, rockeries, terrace, roof and water gardens, Plants suitable for various designs, Landscape designs for public and private buildings, parks and playgrounds etc., Highway and roadside plantations, Developmental cost estimates for landscape.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Arora, J.S. 1992. Introductory Ornamental Horticulture. Kalyani Publishers, New Delhi.
- Booth, N.K. and W.H. Elsevier. 1983. Basic elements in Landscape Architecture Design. Science Publishing Co., New York.

- Khan, M.A., and T.A. Bader. 1992. Landscape Designs, Student Manual. University Printing Press, University of Agriculture, Faisalabad.
- McDaniel, G.L. 1982. Ornamental Horticulture. The Reston Publishing Company; Prentice Hall Co., Reston, Virginia.
- Raj, D. 2002. Floriculture and Landscaping. Kalyani Publisher, New Delhi.

**EC-312**                      **Social Sci Elective-I (Economics for Engineers)**                      **2(1 – 1)**

**Engineering Economics:** Role of engineers in business, Economic decisions v/s design decisions, large scale engineering projects and types of strategic economic decisions, Fundamental principles of engineering economics. **Interest Rate and Economic Equivalence:** Interest: The Cost of Money, Economic Equivalence, Development of Formulas for Equivalence Calculation, Unconventional Equivalence Calculations. **Understanding Money and Its Management:** Nominal and Effective Interest Rates, Equivalence Calculations with Effective Interest Rates and with Continuous Payments, Changing Interest Rates, Debt Management, Investing in Financial Assets, **Present-Worth Analysis:** Project Cash Flows, Initial Project Screening Methods: payback Screening and Discounted, Cash Flow Analysis: Variations of Present-Worth Analysis, Comparing Mutually Exclusive Alternatives. **Annual Equivalent-Worth Analysis:** Annual Equivalent-Worth Criterion, Capital Costs versus Operating Costs, Applying Annual-Worth Analysis, Life-Cycle Cost Analysis, Design Economics, **Rate-of-Return Analysis:** Rate of Return and Methods of Finding, Internal Rate-of-Return Criterion, Mutually Exclusive Alternatives. **Cost Concepts Relevant to Decision Making:** General Cost Terms; Classifying Costs for Financial Statements, Cost Classifications for Predicting Cost Behavior, Future Costs for Business Decisions, Estimating Profit from Production. **Depreciation and Corporate Taxes:** Asset Depreciation: Economic versus Accounting, Book and Tax Depreciation Methods (MACRS), Depletion, Income Tax Rate to be used in Economic Analysis, The Need for cash Flow in Engineering Economic Analysis. **Developing Project Cash Flows:** Cost-Benefit Estimation for Engineering Projects, Developing Cash Flow Statements, **Project Risk and Uncertainty:** Origins of Project Risk, Methods of Describing Project Risk: Sensitivity, Break-Even and Scenario Analysis, **Special Topics in Engineering Economics:** Replacement Decisions, Capital Budgeting Decisions, Economic Analysis in the Service Sector,

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**ENG-316**                      **Technical Writing and Presentation Skills**                      **2(2 – 0)**

**Introduction:** Technical writing, Proposal write-up and improvement strategies Introduction to research, and research types choosing research problems and research advisors How to carry out research, Formulation – Problem statement, Literature, Review, Design – Methodology, Analysis - Data analysis and interpretation Good writing style techniques, Uses of correct words, Presenting and publishing research, Write business/professional correspondence, cover letter and CV Writing meeting minutes.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

Writing for Computer science by Justin Zobel Research Methodologies –A step by step guide for beginners, Ranjit Kumar.



## SEMESTER-VII

**FPM-401**

**Earth Moving Machinery**

**2(1 – 1)**

**Introduction:** Field Capacities and Cost Analysis, Implements Types, Factors affecting field capacity, Cost analysis. **Hydraulics Controls:** Components of a hydraulic system, Types of hydraulic system, Single, Parallel and Series cylinder systems, Limit control, Automatic position, and Draft control. **Power Drives:** Hydrostatic Propulsion drives, PTO drives using two universal joints, Three- joints PTO drives, Loads imposed on P.T.O. shafts, Recommended PTO load limits. **Agricultural Field Machinery and Systems:** Principles of operation, design and selection, Testing, and evaluation of Functional and mechanical performances. **Tillage Force Analysis:** Forces acting upon a tillage implement, Mechanics of tillage, Tillage tool design factors, Measuring and evaluating performance, Measuring draft of implements. **Hitching:** Vertical and horizontal hitching of trailed implement, Hitches for mounted implements, Depth, and draft control on hitches. Crop and soil interaction with machines. **Primary Tillage Implements:** Function and Types of Mold board plows, Components of a mold board plow, Reaction of soils to mold boards, pulverizing action, Turning and inversion, Scouring, Forces acting upon a plow bottom, Effects of soil types, depth of plowing shape and design, Attachments and rear furrow wheel and speed on draft and performance. Functions, components and types of Disk plows, Rotary plows, Chisel, and subsurface plows. **Secondary Tillage Implements:** Functions, components and types of Harrows, Cultivators Land rollers and Pulverizers, Subsurface tillage tools and field cultivators. **Equipment for Sowing and Planting:** Functions, components and types of planting equipment, 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. **Earth Moving Equipment:** Principles and working of Bulldozers, Soil scrapers and ditchers, Crawler, Parts of Crawler, Comparison of wheel type and Crawler tractors.

### **Teaching Methodology (Proposed as applicable):**

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

### **Assessment:**

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

### **Suggested Books:**

- Kepner, R. A., R. Bainer and E. L. Barger. 2005. Principles of Farm Machinery. 3rd Edition, AVI Publishing Company, Inc. Westport, USA.
- Haycraft W. R. – 2002. The Story of the Earthmoving Equipment Industry. Library of Congress cataloging. USA
- Smith H. P. and L. H. Wilkes. (1976). Farm Machinery and Equipment, 6th Ed. McGraw-Hill, Inc. USA
- RNAM Test Codes and Procedures for Farm Machinery, 1995 Economic and Social Commission for Asia and the Pacific Regional Network for Agricultural Machinery, Second Edition C/o UN-EXCAP UN Building, Rajadamnern Nok Avenue, Bangkok, Thailand.

**ID-403**

**Irrigation Engineering**

**3(2 – 1)**

**Introduction:** History of Irrigation, Objectives of irrigation, Scope of Irrigation Engineering. **Water Resources for Irrigation:** Irrigation system of Pakistan, Quantity and Quality of Rainfall, Surface Water and Groundwater, Water budget of Pakistan, Water Resources Issues and their solution, Water resource for hydro power. **Water Law Doctrines:** Transboundary Water Issues, Indus Water Treaty, Distribution of Indus River Water among the provinces, Water apportionment Accord. **Warrabandi System:** Objectives and types of Warrabandi System, Formulation of Warrabandi Schedule, Problems in Warrabandi System. **Crop Water Requirements:** Crop period, base period, duty and delta, relationship between duty and delta, factors affecting duty, depth and frequencies of irrigation, Kharif-Rabi ratio, optimization of irrigation

water, Irrigation efficiencies, uniformity coefficient, Consumptive use of water, effective rainfall, Net irrigation requirements, gross irrigation requirement, Estimation of consumption use, Blaney Criddle, Hargreaves Methods. **Irrigation System Management:** Responsibilities and jurisdiction of institutes managing the water, Farmer's Organizations, Area Water Board (AWB), Assessment of irrigation water charges. **Design of Irrigation Canal:** Design of stable channel, Regime channels, Kennedy's theory, Lacey's theory, Estimation of transported sediment, bed load equations, Design procedure for unlined non-erodible irrigation channel, Maintenance of lined and unlined channels. **Hydraulic Control Structures:** Barrages, weirs, flow regulators, energy dissipaters, Silt control structures in irrigations canals, Cross drainage structures, Canal falls, Flow Measuring structures (gauges, telemetry, stilling wells and others). **Dams/Small Structures:** Classification of dams, Modes of failure, stability analysis, Design of small/mini dam, outlets.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**LWM-405 Engg. Elective-II (Soil and Water Conservation Engineering) 2(1 – 1)**

**Introduction to Soil and Water Conservation:** Soil and Water Conservation, Types of erosion, Effects and importance. **Water Erosion:** Erosion agents, Geologic and accelerated erosion, Damages caused by soil erosion, Water erosion and its types, Factors affecting water erosion, Sedimentation, and pollution in relation to water erosion, Water erosion prediction equation, Erosion control practices. **Wind Erosion:** Factors affecting wind erosion, Types of soil movement, Mechanics of wind erosion, Wind erosion control principles, Wind erosion prediction equation. **Rainfall and Runoff:** Rainfall intensity and duration, Infiltration, Factors affecting runoff, Damages caused by floods, Water harvesting. **Cropping System and Agronomic Measures for Erosion Control:** 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. **Conservation Structures Drops:** Spillways, Chutes and Pipes Spillways; their requirements, components and limitations, Water Conservation, Definition of drought, Effects of drought, Water stored in soil, Decreasing runoff, Reducing evaporation, Reducing deep percolation, Preventing losses from storage.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Linsely, R.K. and Franzini, Joseph. 1996. Water Resources Engineering. McGraw-Hill. FAO.

- Schwab G. O., D.D Fangmeier, W. J. Elliot and R. K. Frevert. (2002). Soil and Water Conservation Engineering, 4th edition. John Wiley and Sons, N.Y.
- Suresh, R. 2012. Soil and water conservation engineering, standard publishers Distributors, 1705-B Nai Sarak, Delhi, India.

**EE-407**

### **Solid Waste Management**

**3(2 – 1)**

**Solid Waste:** Sources and types of wastes, Composition and generation rates, Bio-chemical properties of Wastes, Some typical wastes, Identification of various agricultural wastes. **Integrated Solid Waste Management:** Solid waste in history, Economics in Solid waste, Legislation and regulation, Materials flow, Segregation, Reduction, Reuse, Recycling, Recovery, Disposal, Energy conversion, Need of integrated solid waste management, Municipal solid waste characteristics. **Recycling and Management:** Recycling of wastes, Recycling of plastics, batteries, e-waste, by products of cereals, legumes, oilseeds, fruits and vegetables, Crop, livestock and aquatic waste utilization in various industries, Fermentation of by-products and waste, Furnaces and boilers run on agricultural wastes and by-products, Green House Gas emission and emission modeling, Generation of electricity using surplus biomass/energy recovery. **Solid Waste Management Strategies:** Study and operation of equipment used for size reduction, Mechanical-biological treatment, Digesting and processing of wastes and by-products, Study and operation of equipment/machines used for utilizing various, wastes Composting, Incineration, Study of techniques for bio-gas production utilizing plant and animal, waste Land-filling, Utilization of agricultural wastes for production of manure and animal feed **Landfill:** Planning, siting and permitting of landfills, Landfill processes, Landfill design, Landfill processes. **Processing of Municipal Solid Waste (MSW):** Refuse physical characteristics, Storing of MSW, Conveying, Compacting Shredding, Pulping, roll crushing and granulating. **Material Separation:** Screens, Float Separators, Magnet and electrochemical separators, Materials separation systems, **Combustion and Energy Recovery:** Heat value of refuse, Ultimate analysis, Compositional analysis, Proximate analysis, Calorimetry Materials and thermal balances, Combustion hardware used for MSW, Undesirable effects of combustion. **Biochemical Processes:** Methane generation by anaerobic digestion, Composting, Other biochemical processes. **Current Issues in Solid Waste Management:** Life cycle analysis and management, Flow control, Financing solid waste facilities, calculating annual cost, Calculating percent worth, Calculating sinking funds, Calculating capital plus O&M cost, Comparing alternatives Hazardous material.

#### **Teaching Methodology (Proposed as applicable):**

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

#### **Assessment:**

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

#### **Suggested Books:**

- Worrell, W.A. and Vesilind, P.A., 2011. Solid waste engineering. Cengage Learning.
- Gottinger, H.W., 2018. Economic models and applications of solid waste management. Routledge.
- Worrell, W.A., Vesilind, P.A. and Ludwig, C., 2016. Solid waste engineering: a global perspective. Nelson Education.

**FS-409**

### **Farm Structures and Control Sheds**

**3(2 – 1)**

**Introduction:** Definition and types of farm service buildings, structural materials, and their uses. **Farm Stead:** Definition, site selection developing a farmstead plan, arrangement of farmstead buildings. **Farm Building Design:** Planning the farm homes, dairy cattle housing, poultry housing, sheep housing, care and maintenance of farm buildings. **Dairy Building:** Functional planning, Environment, Sanitation, Space requirements for animals and traffic, arrangement of space, other considerations, Milking Parlors, Pen vs Stall Barns, Storage or feed, Milk, and manure etc., Insulation and ventilation, Design of Dairy Building. **Poultry Housing:** Functional planning, Production practices, Environment, Space requirements, Arrangement or space, Insulation and ventilation, other considerations, Design of Poultry House. **Storage:**

Characteristics of grains, fiber, fruits and vegetables, structural requirements for them, economics aspects of farm buildings and structures. **Estimating and Costing:** Need for Estimation and Costing, Procedure of Estimating or Method of Estimating, Data required to prepare an Estimate, Drawings, Specifications, Rates, Complete Estimate, Measurement of Materials & Works, Types of Estimates, Detailed estimate, Data, Methods of Preparation of Approximate Estimation, estimation of quantities of steel & RCC elements, Farm Bridges, Roads, Fences, Green Houses, Gates, Feed lot Equipment and Animal Handling Equipment.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**AE-411 Final Year Design Project (FYDP)-I 3(0 – 3)**

FYDP aims to challenge innovative, creative, technical, management and presentation skills of a graduate to bring together the learning over the degree program. A final year design project (FYDP) is the confluence of an engineering program. Undertaking a final year design project is a compulsory requirement. It should mainly comprise literature search, individual analysis, modeling and simulation, AI (Artificial Intelligence) and computational data analytics, design and putting together various hardware, software, firmware and Algorithm Engineering / Informatics related to the program to demonstrate a functional concept including rapid prototyping, where applicable. The FYDP shall include complex engineering problems and design systems, components or processes integrating core areas and meeting specific needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. A project of this nature should invariably lead to an integration of the knowledge and practical skills as mandated in the program outcomes. In this context, projects of multidisciplinary nature should be encouraged. The FYDP should span over two consecutive semesters, i.e., semester 7 & 8, totaling 6-credit hours and should be fully supervised, assessed and reflected in the transcripts under a prescribed mechanism so as to prepare for joining industry after graduation.

**AE-413 Internship 3(0 – 3)**

Internship of at least 6 - 8 weeks is mandatory part of degree requirements towards 3rd to 4th year of program; must be supervised, monitored, evaluated, and reflected in the transcripts under a prescribed mechanism and with defined and mapped rubrics with program

Objectives. Selection of internship in line with elective subjects/ specific streams

Qualifying weightage: 70%

- ✓ At least 75% attendance is mandatory 10%
- ✓ Assessment report from the employer 50%
- ✓ Evaluation at relevant HEIs/ Deptt – presentation 40%

## SEMESTER-VIII

**ID-402**

**Drainage Engineering**

**3(2 – 1)**

**Introduction:** Definition, sources, history and adverse effects of agricultural drainage, Salient features of drainage projects in Pakistan, Desirable water table depth, Ground water table depth and crop yields, Identification of drainage problems, Solution of the drainage problems, Comparison of different drainage systems. **Soil Water Relations:** Soil hydraulic characteristics (types, pores spaces, water pressure, distribution in the soil profile, Surface tension, capillary pressure, Saturated, Unsaturated hydraulic conductivity, Drainable pore space), Soil moisture retention curves. **Waterlogging and Salinity:** Accumulation of salts at the soil surface, Type of Salinity, Treatment procedures. **Theories of Sub-Surface Pipe:** Drainage Theory of ground water flow to drains, Steady state drainage design, Drainage system design equations (Hooghoudt equation, Partial, penetration of drains, Kirkham solution, Ernst Equation, Donan equation, Modified Donan equation, Drainage design for anisotropic soils, Van beers formula, Drainage of artesian pressure, Unsteady state drainage equation, Glove-Dumm formula, De-Zeeuw-Helinga model). **Sub-Surface Horizontal Drainage System:** Design, Construction and Operation, Drains system's layout, Drain pipe, Pipe envelop, Gravel envelope design, Synthetic envelop design, Placement of envelop, materials Tile drainage system, Construction of pipe drain system, Drainage machinery, Pipe installation below the water table, Drainage structures, Checking performance of pipe drainage systems, clogging of drain pipe, slots and envelop Pipe cleaning (operation and maintenance issues), Effluent disposal and re-use. **Surface Drainage System Design:** Design variables and parameters BP-Q, General procedure for drain design, drain alignment/location, drain design discharge, Hydraulic grade line and hydraulic gradient, Permissible flow velocities, Drain structures, Operation and maintenance of drains. **Vertical Drainage System:** Drainage mechanism, Tube wells and groundwater drainage, Advantages of tube well drainage, Drainage coefficient for well drainage, Tube well size selection, Number of pumping tube wells, Tube well layout, Effluent disposal, **Operation and Maintenance of Drainage System:** Buried Pipe drainage system, Open drainage system, Drainage water disposal ponds, Drainage observation well, Policy and basic requirements, weed control and embankment stability.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

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

**LWM-404**

**Engg. Elective-III (Farm Water Management)**

**3(2 – 1)**

**Watercourse Design and Improvement:** Introduction, Planning for watercourse improvement, Design criteria, Hydraulics of watercourse design, Different cross sections of watercourse, Materials, and procedures, Moghas, Construction of unlined and lined watercourses, OFWM structures (conveyance, control). **Water Management through Precision Land Leveling** Precision land leveling, Objective, Advantages and disadvantages of land leveling Farm assessment and layout, Traditional survey layout procedure, Adjustment of borrow and fill, Procedure for sloping fields, Land leveling maintenance. **Water Storage Tanks:** Sizing a water storage tanks, Considerations in sizing water storage tanks, General criteria, Design of storage tanks, Construction of water storage tank, Preparatory works, Materials and

procedures, Concrete base, Brick or stone walls, Concrete walls, Backfilling, Stone pitching, Quantities, **Water Harvesting** Introduction, Goals and objectives, Site selection, Area appraisals, Topographical surveys, Land use plan and work plan, Land development and conservation structures, Leveling and terracing, Improved bunds, Improved tillage, Field spillways, Water ways, 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, Conjunctive Use of Water, Conjunctive use of saline groundwater, Effects of sediment and salinity on conjunctive use of water.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- On Farm Water Management Field Manuals, (Revised 1996-97)
- Vol. IV Watercourse Design and Improvement.
- Vol. V Land Development Precision Land Leveling and level Border Design.
- Vol. VI Irrigation Agronomy.
- Vol. VII Water Storage Tanks.
- Vol. X Water Harvesting and Spate Irrigation
- Ministry of Food, Agriculture and Livestock (Federal Water Management cell) Government of Pakistan, Islamabad. Hoffman, G. J, T.A. Howell and K.H. Solomon, 1992. Management of Farm Irrigation Systems. ASAE.

**FS-406**

**Agricultural Process Engineering**

**3(2 – 1)**

**Introduction:** Importance of Agricultural Process Engineering for value addition, Structure and composition of food grains and fruits, Physical, mechanical, and thermal properties of agricultural materials.

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

**Material Handling and Transportation equipment:** Belt conveyors, chain conveyors, Pneumatic conveyors, gravity conveyors, Bucket elevators augers, trailer/ trucks. **Cleaning, Sorting and Grading:** Grade factors, washing types and methods of washing, Sorting fruits and vegetables, types of sorters, cleaning and sorting, Grading, nuts and seeds, types of grain cleaners/sorter, Aerodynamics of small particles, types of separators, Machine vision and its applications in grading. **Size Reduction:** Types of size reduction mills, fineness modulus, Value of ground feed, size relationships, energy requirements, Size reduction procedures, reducing devices, Performance, and characteristics of size reduction devices, Mixing and types of mixers. **Cold Storages:** Need of cold storages, types of cold storages and their design, Temperature and humidity controls, heat load, Automation of cold storages, Air conditioning, aeration, storage temperatures for various horticultural produce. **Drying:** Drying and dehydration, Moisture content determinations; primary methods, equilibrium moisture, content, Drying processes, constant rate period, falling rate period, falling rate drying mechanism, Dynamics of equilibrium moisture content, effect of temperature upon the rate of drying, Effect of air rate upon the rate of drying, heat and mass balance limitation of the drying Equipment, types of driers psychrometric chart, calculations, Design of drying systems using computer simulation. **Milling and Extraction:** Grain handling systems. Corn wet and dries milling. Rice milling. Extraction of Canola and Cottonseed oils. **Packaging Material:** Packaging materials and techniques, Material properties, packing geometries.

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Henderson, S.M. 2010. Agricultural Process Engineering. The AVI Publishing Company, Inc. Westport, Connecticut. USA.
- Dabhi, M.N. and N.K. Dhamsaniya. 2008. Agricultural Process Engineering. Agrotech Publishing Academy, India.
- Toledo, R.T. 2006. Fundamentals of Food Process Engineering. Food Science Text Series.
- Pandey, H. H. K. Sharma, R. C. Chauhan, B. C. Sarkar, and M. B. Bera. 2004. Experiments in food process engineering. CBS Publishers and distributors, New Delhi, India

**FS-406****MDE Elective-II (Alternate and Renewable Energy)****3(2 – 1)**

**History of Energy Usage**, forms of energy, present energy consumption, environmental problems, and Current status of conventional and renewable energy sources: World and Pakistan scenario, energy, and power; **Fossil Fuel Resources (Oil, Gas, Coal) Solar Thermal Energy:** a. Solar radiation resource, b. Passive and active solar heating, c. Solar Concentrators. **Solar Photovoltaic:** a. Components of PV systems and operation. **Biomass:** a. Biomass resource, b. Extracting biomass energy, c. Fuel crops, d. Anaerobic digestion, e. Landfill gas, f. Waste to energy. **Hydroelectricity:** a. Hydro power Resource, b. Hydropower power equation, c. Introduction to turbines, d. large and small scales systems, e. Pumped storage, f. Tidal Power, g. The tides, tidal resource, system operation, environmental factors. **Wind Energy:** a. Generation of the winds b. Wind resource, c. Basic aerodynamics (lift versus drag) and the fundamental power equation, d. Fundamental design concepts. **Wave Energy:** a. The wave resource, b. The fundamental power equation, c. Onshore and offshore wave energy extraction systems. **Geothermal Energy:** a. Nature of Fields, b. Classification of Geothermal Resources, c. Introduction to geothermal steam electric plants, d. Liquid Dominated System: Flashed Steam System, Total Flow Concept, and Geothermal exploration. **Fuel Cell:** a. Introduction and Classification, b. Reactions and Configurations. **Nuclear Energy**

**Teaching Methodology (Proposed as applicable):**

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

**Assessment:**

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

**Suggested Books:**

- Duffie, J.A. and W.A. Beckman. 2013. Solar Engineering of Thermal Processes, 3rd Edition, John Wiley & Sons.
- Boyle, G. Renewable Energy: Power for a Sustainable Future. 2<sup>nd</sup> Edition, OUP, and Open University, 2004, ISBN 019926178-4.
- Boyle, G., B. Everett, and J. Ramage. 2003. Energy Systems and Sustainability, OUP, and Open University, 2004, ISBN-13: 9780199261796.
- Scheer, H., A Solar Manifesto, James & James, 2004, ISBN 1 902916 247.
- Kalogirou, S.A. 2009. Solar Energy Engineering: Processes and Systems. 1st Ed. British Library. ISBN 978-0-12-374501-9. Printed in USA.
- B. Viswanathan, M. Aulice Scibioh. 2007. Fuel Cells: Principles and Applications. Taylor & Francis Group, 2007.