CURRICULUM (2024 ONWARDS)

Course Scheme for Session-2024 and onwards

Course Code	Title	Contact Hours	Credit Hours	Pre-requisite
1.	**Knowledge Area: Arts, Humanities and Social Sciences**	**(20 Credit Hours)**		
XXXXX	Social Science Elective	2(2, 0)	2(2, 0)	None
HU-200	Technical Report Writing	3(3, 0)	3(3, 0)	None
HU-111L	Communication Skills	3(0, 3)	1(0, 1)	None
IS-102	Islamic Studies/ Ethics (for non-Muslim students)	3(3, 0)	3(3, 0)	None
IS-202	Ideology and Constitution of Pakistan	3(3, 0)	3(3, 0)	None
QT-101	Translation of Holy Quran-I	1(1, 0)	1(1, 0)	None
QT-201	Translation of Holy Quran-II	1(1, 0)	1(1, 0)	None
QT-301	Translation of Holy Quran-III	1(1, 0)	1(1, 0)	None
QT-401	Translation of Holy Quran-IV	1(1, 0)	1(1, 0)	None
MGT-349	Entrepreneurship	2(2, 0)	2(2, 0)	None
HU-212	Civics and Community Engagement	2(2, 0)	2(2, 0)	None
HU-003	International Language	3(3, 0)	0(0, 0)	None
	Social Science Elective			
Pet. E-312	Petroleum Economics and Risk Management	2(2, 0)	2(2, 0)	None
OR				
IME-371	Engineering Economics	2(2, 0)	2(2, 0)	None
*** For non-Muslim in lieu of ‘‘Translation of Holy Quran’’ following courses:**				
Pet. E-151	Mini Project-I	1(1, 0)	1(1, 0)	None
Pet. E-251	Mini Project-II	1(1, 0)	1(1, 0)	None
Pet. E-351	Mini Project-III	1(1, 0)	1(1, 0)	None
Pet. E-451	Mini Project-IV	1(1, 0)	1(1, 0)	None
	OR			
SE-101	Social Ethics-I	1(1, 0)	1(1, 0)	None
SE-201	Social Ethics-II	1(1, 0)	1(1, 0)	None
SE-301	Social Ethics-III	1(1, 0)	1(1, 0)	None
SE-401	Social Ethics-IV	1(1, 0)	1(1, 0)	None
2.	**Knowledge Area: Computer Skills**	**(03 Credit Hours)**		
CSC-100	Applications of Information and Communication Technologies	5(2, 3)	3(2, 1)	None
3.	**Knowledge Area: Formal and Natural Sciences**	**(15 Credit Hours)**		
MA-123	Calculus	3(3, 0)	3(3, 0)	None
MA-129	Vector and Complex Analysis	3(3, 0)	3(3, 0)	None
MA-225	Differential Equations and Transforms	3(3, 0)	3(3, 0)	None
MA-240	Numerical Analysis	5(2, 3)	3(2, 1)	None

	Knowledge Area-Natural Sciences/Math Elective			
Phy-115	Applied Physics	5(2, 3)	3(2, 1)	None
4.	**Knowledge Area: Management Sciences**	**(02 Credit Hours)**		
MGT-320	Project Management in Engineering	2(2, 0)	2(2, 0)	None
5.	**Knowledge Area: Computer and Information Sciences**	**(06 Credit Hours)**		
CS-103	Introduction to Computer Programming for Data Science	5(2, 3)	3(2, 1)	None
CMPE-442	Machine Learning	3(3, 0)	3(3, 0)	None
6.	**Knowledge Area: Foundation Engineering Courses**	**(23 Credit Hours)**		
ME-100L	Workshop Practice	3(0, 3)	1(0, 1)	None
Pet. E-101	Fundamentals of Petroleum Engineering	3(3, 0)	3(3, 0)	None
Pet. E-102	Petroleum Geology & Geophysics	3(3, 0)	3(3, 0)	None
CE-216	Strength of Materials	5(2, 3)	3(2, 1)	None
CE-233	Fluid Mechanics	5(2, 3)	3(2, 1)	None
Ch. E-253	Applied Thermodynamics	5(2, 3)	3(2, 1)	None
EE-201	Electrical Engineering and Electronics	5(2, 3)	3(2, 1)	None
ME-120L	Engineering Drawing & Graphics	3(0, 3)	1(0, 1)	None
Min-E-101	Applied Geology	5(2, 3)	3(2, 1)	None
7.	**Knowledge Area: Core Breadth of Engineering Discipline**	**(23 Credit Hours)**		
Pet. E-203	Petrophysics	5(2, 3)	3(2, 1)	None
Pet. E-204	Drilling Engineering - I	6(3, 3)	4(3, 1)	None
Pet. E-314	Reservoir Engineering	6(3, 3)	4(3, 1)	None
Pet. E-315	Petroleum Production Engineering-I	6(3, 3)	4(3, 1)	None
Pet. E-318	Properties of Reservoir Fluids	6(3, 3)	4(3, 1)	None
Pet. E-321	Natural Gas Processing and Transportation	6(3, 3)	4(3, 1)	None
8.	**Knowledge Area: Core Depth of Engineering Discipline**	**(23 Credit Hours)**		
Pet. E-311	Well Logging and Interpretation	6(3, 3)	4(3, 1)	None
Pet. E-411	Drilling Engineering - II	6(3, 3)	4(3, 1)	Pet. E-204
Pet. E-422	Principles of Reservoir Simulation	5(2, 3)	3(2, 1)	None
Pet. E-425	Petroleum Production Engineering-II	6(3, 3)	4(3, 1)	Pet. E-315
Pet. E-427	Reservoir Management	6(3, 3)	4(3, 1)	None
Pet. E-429	Principles of Enhanced Oil Recovery	6(3, 3)	4(3, 1)	None
9.	**Knowledge Area: Interdisciplinary Engineering Courses**	**(06 Credit Hours)**		
Pet. E-103L	Occupational Health and Safety	3(0, 3)	1(0, 1)	None
Pet. E-201	Reservoir Geomechanics	2(2, 0)	2(2, 0)	None
Pet. E-323	Field Operations in Petroleum Engineering	3(3, 0)	3(3, 0)	None

10.	**Internship**	**(00 Credit Hours)**		
Pet. E-461	Internship			
11.	**Knowledge Area: Final Year Design Project**	**(06 Credit Hours)**		
Pet. E-498	Final Year Design Project (Phase-I)	9(0, 9)	3(0, 3***)	None
Pet. E-499	Final Year Design Project (Phase-II)	9(0, 9)	3(0, 3)	Pet. E-498
12.	**Knowledge Area: Flexible Courses**	**(09 Credit Hours)**		
Pet. E-319	Well Test and Analysis	5(2, 3)	3(2, 1)	None
CY-171	Petroleum Chemistry	5(2, 3)	3(2, 1)	None
	Elective – I**	5(2,3)/3(3, 0)	3(2, 1)/3(3, 0)	None

**** Elective – I:**

Pet. E-301	Geo-Energy Resources	3(3, 0)	3(3, 0)	None
Pet. E-302	Unconventional Resources	3(3, 0)	3(3, 0)	None
Pet. E-303	Well Completion	3(3, 0)	3(3, 0)	None
Pet. E-304	Offshore Field Development	3(3, 0)	3(3, 0)	None
Pet. E-305	Principles of Corrosion Control	3(3, 0)	3(3, 0)	None
Ch. E-352	Chemical Technology of Petroleum	5(2, 3)	3(2, 1)	None
Ch. E-361	Instrumentation and Control	5(2, 3)	3(2, 1)	None
Min-E-359	Surveying & Levelling	5(2, 3)	3(2, 1)	None

* For non-Muslim students, respective alternate subjects will be offered.

** One subject will be offered.

*** Will be evaluated at the end of 8th Semester.

Semester-wise Sample scheme of Study

SEMESTER I					
Course No.	Course Code	Course Title	Credit Hours		Pre-requisite
			Theory	Practical	
1	Pet. E-101	Fundamentals of Petroleum Engineering	3	0	None
2	CSC-100	Applications of Information and Communication Technologies	2	1	None
3	HU-111L	Communication Skills	0	1	None
4	IS-102	Islamic Studies/ Ethics (For non-Muslim students)	3	0	None
5	MA-123	Calculus	3	0	None
6	ME-120L	Engineering Drawing & Graphics	0	1	None
7	Min E-101	Applied Geology	2	1	None
8	QT-101	Translation of Holy Quran-I*	1	0	None
		TOTAL	**14**	**4**	
		GRAND TOTAL	**18**		

SEMESTER II					
Course No.	Course Code	Course Title	Credit Hours		Pre-requisite
			Theory	Practical	
1	Pet. E-102	Petroleum Geology & Geophysics	3	0	None
2	Pet. E-103L	Occupational Health and Safety	0	1	None
3	CS-103	Introduction to Computer Programming for Data Science	2	1	None
4	CY-171	Petroleum Chemistry	2	1	None
5	MA-129	Vector and Complex Analysis	3	0	None
6	ME-100L	Workshop Practice	0	1	None
7	Phy-115	Applied Physics	2	1	None
		TOTAL	**12**	**5**	
		GRAND TOTAL	**17**		

SEMESTER III					
Course No.	Course Code	Course Title	Credit Hours		Pre-requisite
			Theory	Practical	
1	Pet. E-203	Petrophysics	2	1	None
2	Pet. E-204	Drilling Engineering-I	3	1	None
3	CE-216	Strength of Materials	2	1	None
4	EE-201	Electrical Engineering and Electronics	2	1	None
5	HU-003	International Language	0	0	None
6	HU-212	Civics and Community Engagement	2	0	None
7	MA-225	Differential Equations and Transforms	3	0	None
		TOTAL	**14**	**4**	
		GRAND TOTAL	**18**		

SEMESTER IV					
Course No.	Course Code	Course Title	Credit Hours		Pre-requisite
			Theory	Practical	
1	Pet. E-201	Reservoir Geomechanics	2	0	None
2	CE-233	Fluid Mechanics	2	1	None
3	Ch. E-253	Applied Thermodynamics	2	1	None
4	HU-200	Technical Report Writing	3	0	None
5	IS-202	Ideology and Constitution of Pakistan	3	0	None
6	MA-240	Numerical Analysis	2	1	None
7	QT-201	Translation of Holy Quran-II*	1	0	None
		TOTAL	**15**	**3**	
		GRAND TOTAL	**18**		

SEMESTER V					
Course No.	**Course Code**	**Course Title**	**Credit Hours**		**Pre-requisite**
			Theory	**Practical**	
1	Pet. E-311	Well Logging and Interpretation	3	1	None
2	Pet. E-314	Reservoir Engineering	3	1	None
3	Pet. E-319	Well Test and Analysis	2	1	None
4	Pet. E-321	Natural Gas Processing and Transportation	3	1	None
5	MGT-320	Project Management in Engineering	2	0	None
6	QT-301	Translation of Holy Quran-III*	1	0	None
		TOTAL	**14**	**4**	
		GRAND TOTAL	**18**		

SEMESTER VI					
Course No.	**Course Code**	**Course Title**	**Credit Hours**		**Pre-requisite**
			Theory	**Practical**	
1	Pet. E-315	Petroleum Production Engineering-I	3	1	None
2	Pet. E-318	Properties of Reservoir Fluids	3	1	None
3	Pet. E-323	Field Operations in Petroleum Engineering	3	0	None
4	XXXXX	Social Science Elective	2	0	None
5	MGT-349	Entrepreneurship	2	0	None
6		Elective -I**	3/ 2	0/ 1	None
		TOTAL	**16/ 15**	**2/ 3**	
		GRAND TOTAL	**18**		

SEMESTER VII					
Course No.	**Course Code**	**Course Title**	**Credit Hours**		**Pre-requisite**
			Theory	**Practical**	
1	Pet. E-422	Principles of Reservoir Simulation	2	1	None
2	Pet. E-425	Petroleum Production Engineering-II	3	1	Pet. E-315
3	Pet. E-461	Internship	0	0	None
4	CMPE-442	Machine Learning	3	0	None
5	Pet. E–498	Final Year Design Project (Phase-I) ***	0	3	None
		TOTAL	**8**	**5**	
		GRAND TOTAL	**13**		

SEMESTER VIII					
Course No.	**Course Code**	**Course Title**	**Credit Hours**		**Pre-requisite**
			Theory	**Practical**	
1	Pet. E-411	Drilling Engineering-II	3	1	Pet. E-204
2	Pet. E-427	Reservoir Management	3	1	None
3	Pet. E-429	Principles of Enhanced Oil Recovery	3	1	None
4	QT-401	Translation of Holy Quran-IV*	1	0	None
5	Pet. E–499	Final Year Project (Phase-II)	0	3	Pet. E- 498
		TOTAL	**10**	**6**	
		GRAND TOTAL	**16**		

TOTAL DEGREE CREDIT HOURS	**103/ 102**	**33/ 34**
DEGREE GRAND TOTAL	**136**	

Program Summary

Domain	Knowledge Area	Credit	
		PEC/ UET	PET
Non-Engineering	Arts, Humanities and Social Sciences	20	20
	Computer Skills	3	3
	Formal and Natural Sciences	15	15
	Management Sciences	2	2
	Sub Total	**Min 40**	**40**
Engineering	Computing	72	6
	Foundation Engineering Courses		23
	Core Breadth of Engineering Discipline		23
	Core Depth of Engineering Discipline		23
	Multidisciplinary Engineering Courses	5	6
	Final Year Design Project	6	6
	Internship	0	0
	Flexible Courses	7-13	9
	Sub Total	**Min 90**	**96**
Grand Total		**130-136**	**136**

University Vision:
To generate knowledge for global competitive advantage and become a leading world class research University.

Departmental Mission:
To transform young brains into brilliant Petroleum Engineers, through modern teaching and research, to achieve professional excellence in oil and gas industry.

Program Educational Objectives

1. To equip graduates with updated engineering knowledge and research skills for examining and solving complex industry problems.
2. To enhance graduates' interpersonal, teamwork and management skills while focusing on socio-economic development in an eco-friendly manner.
3. To develop an aptitude for lasting personal capacity-building through continued professional development, along with integrity and a sense of ethical norms and values.

Mapping of PEOs to Graduate Attributes/ PLOs

Graduate Attributes/ PLOs	PEO-1	PEO-2	PEO-3
Engineering Knowledge	■		
Problem Analysis	■		
Design/Development of Solutions	■		
Investigation	■		
Tool Usage	■		
The Engineer and the World		■	
Ethics			■
Individual and Collaborative Teamwork		■	
Communication		■	
Project Management and Finance		■	
Lifelong Learning			■

Graduate Attributes/ Program Learning Outcomes (PLOs):

It is expected that at the time of graduation the students of Petroleum & Gas Engineering program must have attained a specific set of knowledge, skills and behavioral traits. The eleven (11) GAs/PLOs that have been adopted by the Petroleum & Gas Engineering Program at UET, Lahore, given as follows:

1. **Engineering Knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and Engineering specialization to the solution of complex engineering problems (WK1-WK4).
2. **Problem Analysis:** Identify, formulate, conduct research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (WK1-WK4).
3. **Design/Development of Solutions:** An ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations (WK-5).
4. **Investigation:** Conduct investigation of complex Engineering problems using research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions (WK-8).
5. **Tool Usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex Engineering problems, with an understanding of the limitations (WK2 and WK-6).
6. **The Engineer and the World:** Analyze and evaluate sustainable development impacts to society, the economy, sustainability, health and safety, legal frameworks, and the environment while solving complex engineering problems (WK-1, WK-5, and WK-7).
7. **Ethics:** Apply ethical principles and commit to professional ethics and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion (WK-9).
8. **Individual and Collaborative Teamwork:** Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings (WK-9).
9. **Communication:** Communicate effectively and inclusively 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, and make effective presentations, taking into account cultural, language, and learning differences (WK-1 and WK-9).
10. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision making and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments (WK-2 and WK-5).

11. **Lifelong Learning:** Recognize the need for and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change (WK-8 and WK-9).

Knowledge and Attitude Profile (WKs)

To inculcate different dimensions of thinking mathematical, computational, design and creativeness among students in Cognitive, Psychomotor and Affective domains, the curriculum is designed to cover the following 9x knowledge and attitude profiles. These profiles reflect an indicated volume of learning and the work attitude against which graduates must be able to perform:

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling; applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the relevant engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development (Represented by the 17 UN Sustainable Development Goals (UN-SDG)

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct; Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability, etc. with mutual understanding and respect, and of inclusive attitudes.

Engineering Competencies (ECs)

Professional competence can be described using a set of attributes corresponding largely to the graduate attributes, but with different emphases. For example, at the professional level, the ability to take responsibility in a real-life situation is essential. Unlike the graduate attributes, professional competence is more than a set of

attributes that can be demonstrated individually. Rather, competence must be assessed holistically. Thirteen elements of professional competence as approved by the IEA for global benchmarking are mentioned as follows:

EC1 Comprehend and apply universal knowledge: Comprehend and apply advanced Engineering knowledge of the widely applied principles underpinning good practices.

EC2 Comprehend and apply local knowledge: Comprehend and apply advanced Engineering knowledge of the widely applied principles underpinning good practice specific to the jurisdiction of practices.

EC3 Problem analysis: Define, investigate and analyze complex Engineering problems using data and information technologies where applicable.

EC4 Design and development of solutions: Design or develop solutions to complex Engineering problems considering a variety of perspectives and taking account of stakeholder views.

EC5 Evaluation: Evaluate the outcomes and impacts of complex Engineering activities.

EC6 Protection of society: Recognize the foreseeable economic, social, and environmental effects of complex Engineering activities and seek to achieve sustainable outcomes.

EC7 Legal, regulatory, and cultural: Meet all legal, regulatory, and cultural requirements and protect public health and safety in the course of all Engineering activities.

EC8 Ethics: Conduct Engineering activities ethically.

EC9 Manage engineering activities: Manage part or all of one or more complex Engineering activities.

EC10 Communication and Collaboration: Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders in the course of all Engineering activities.

EC11 Continuing Professional Development (CPD) and Lifelong learning: Undertake CPD activities to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever-changing nature of work.

EC12 Judgement: Recognize complexity and assess alternatives in light of competing requirements and incomplete knowledge. Exercise sound judgement in the course of all complex Engineering activities.

EC13 Responsibility for decisions: Be responsible for making decisions on part or all of complex Engineering activities.

Courses Details

CSC-100 APPLICATIONS OF INFORMATION AND COMMUNICATION TECHNOLOGIES

(Subject to the changes as defined by the concerned department)

Introduction to Computer Systems, Basic Operations and Components of a Generic Computer System, Processing Data, Internet Basics, Introduction to Embedded Systems, Networking Basics, Database Management, Protecting your privacy, your computer and your data, ICT Applications, Future Trends in ICT

LAB OUTLINES:

As defined by the concerned department (who owns the subject).

RECOMMENDED BOOKS:

1. Discovering Computers by Vernmaat, Shaffer, and Freund.
2. GO! With Microsoft Office Series by Gaskin, Vargas, and McLellan.
3. Exploring Microsoft Office Series by Grauer and Poatsy
4. Computing Essentials by Morley and Parker
5. Technology in Action by Evans, Martin and Poatsy

CS-103 INTRODUCTION TO COMPUTER PROGRAMMING FOR DATA SCIENCE

(Subject to the changes as defined by the concerned department)

This course serves as an introduction to computer programming. We will study and implement the standard introductory topics of Python. Besides that, we will learn the applications of programming to data science. Introduction to Computers and Python, Python programming, programming logic, conditional statements, repetition structures, functions: case study, Sequence: lists and tuples, dictionaries and sets, array-oriented programming with NumPy, manipulating strings, files and exceptions,

LAB OUTLINES

Various Programming codes

RECOMMENDED BOOKS:

1. . Paul Deitel & Harvey Deitel, “Intro to Python® for Computer Science and Data Science: Learning to Program with AI, Big Data and the Cloud”, Pearson Education, Inc. 2020.

2. Wes McKinney, "Python for Data Analysis", O'Reilly Media, Inc, 2018.
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, Inc, 2017.

CMPE-442 MACHINE LEARNING

(Subject to the changes as defined by the concerned department)

This course provides students with an in-depth introduction to the two main areas of Machine Learning: supervised and unsupervised learning. Will cover some of the main models and algorithms for regression, classification, clustering from two approaches: probabilistic methods and non-probabilistic methods. Different application areas of machine learning such as bioinformatics, text analytics and marketing and sales will be discussed as case studies in this course.

RECOMMENDED BOOKS:

1. Bayesian Reasoning and Machine Learning by David Barber
2. 2012 Pattern Recognition and Machine Learning by Christopher Bishop, 2006 Tom Griffiths
3. webpage: http://cocosci.berkeley.edu/tom/bayes.htmlManning and Schütze (1999):
4. Foundations of Statistical Natural Language Processing,

CY-171 PETROLEUM CHEMISTRY

(Subject to the changes as defined by the concerned department)

Petroleum chemistry: Basic introduction, General characteristics, Nature, composition and chemical constitution of crude oil and natural gases

Instrumental and Spectroscopic Analytical Techniques:

Principles of spectroscopy, Electromagnetic spectrum, UV-Visible, IR, AAS spectroscopy, Mass Spectrometry, proton NMR

Physico-Chemical methods of Separation and Analysis

Chromatography, Basic principles and classification, column chromatography, paper and thin layer, ion exchange, gel permeation, gas and high performance liquid chromatographic methods, electrophoresis,

Statistical Data Treatment

Introduction, Types of Errors, Accuracy and Precision, Determinate and Indeterminate Errors, Mean, Median, Range, Variance, Coefficient of Variance, Q-Test, t-Test, F-Test, Standard Deviation, Relative Standard Deviation, Mean Standard Deviation, Confidence limit, Significant and Insignificant Figures, Numerical.

LAB OULINES:

1. Determination of Heat of Solution of a given salt solution.

2. Determination of Heat of Neutralization of given Acid-Base pair.
3. Determination of the Surface Tension of a given liquid by using Stalagmometer
4. Determination of Viscosity of a given liquid by using Ostwald's viscometer
5. Determination of the strength of Acid/Base by conductometric titration
6. Determination of the strength of Acid/Base by potentiometric titration
7. Separation of provided black ink by Thin Layer Chromatography
8. Separation of Food Dyes by Paper Chromatography
9. Separation of Metal Cations by Paper Chromatography
10. Determination of Errors
11. Determination of the strength of provided ion using complexometric titration
12. Determination of the strength of provided analyte using gravimetric analysis
13. Preparation of buffers solutions
14. Determination of percentage composition of provided analyte solution using spectrophotometric analysis.

RECOMMENDED BOOKS

1. Standard Handbook of Petroleum and Natural Gas Engineering, Volume I, William C. Lyons, Gulf Publishing Company, Texas.
2. Modern Fourier Transform Infra-red Spectroscopy, by Chiristy, A. A, Y. Ozaki, and V. G. Gregorou, Elsevier.
3. Inorganic Mass Spectrometry: Fundamentals and Applications 1st Edition by Barshick, Christopher M., Douglas C, Duckworth, and David H, Smith Marcel Dekker,
4. Organic Spectroscopy 3rd edition by William Kemp, MACMILLAN.
5. X-Ray Fluoriscence Spectrometry, 2nd Edition by Jenkins, Ron, John Wiley & Sons.
6. Analytical Chemistry 5th edition by Gary D. Christian, John Wiley & Sons.
7. Fundamentals of Analytical Chemistry 5th edition by Skoog, West and Holler, Saunders Collage Publishing.

HU-003 INTERNATIONAL LANGUAGE

(Subject to the changes as defined by the concerned department).

The aim of the course is to provide students with an international language to make them familiar with the international language, norms, culture and how to work in a particular country. This course contains vocabulary use, speaking, and routine communications for all technical and social purposes.

HU-111L COMMUNICATION SKILLS

(Subject to the changes as defined by the concerned department).

Week	Main Topics	Lecture contents
1	Introduction to Communication Skills	A. Communication Principles B. Process of communication. C. Importance of good communication skills in business environments
2	Introduction to Communication Skills	A. Communication in business organizations I. Internal-operational II. External-operational III. Personal B. Challenge of communication in the global market.
3	Study Skills	A. Brain storming B. Time-management C. Effective reading strategies D. Note-taking E. Organization F. Summarizing
4	Components of Communication	A. Context B. Sender-Encoder C. Message D. Medium E. Receiver-decoder F. Feedback
5+6	Non-Verbal Communication	A. Appearance and dress codes B. Body language C. Silence, time and space D. Importance of listening in communication
7	Functional English	Role-play/Speaking activities
8	Public Speaking	A. Difference between speaking and writing. B. Reading texts of good public speeches and analysis of their components.
9	Public Speaking	C. Listening to famous public speeches. D. Exercise in public speaking.
10	Formal Presentations	A. Difference between informal and formal presentations B. Modes of formal presentation I. Extemporaneous II. Prepared III. Reading out form a written text IV. Combination of the above mentioned methods.
11	Formal Presentations	C. Purpose of oral presentations I. Entertain II. Persuade III. Inform IV. Sell D. Mechanics of Presentations I. Organization II. Preparation (including A V As) III. Rehearsals IV. Presentations E. Teacher shall mode presentations both, with and without A V As

12	Resume/CV Writing	Cover Letters, Resumes, CVs
13	Interview Skills	Practice/Viva
14+15	Formal Presentations	Students Presentation

RECOMMENDED BOOKS:

1. Introduction to Business Communication by Zane K. Quible, Margaret H. Johson & Dennis L. Mott.
2. Business Communication Today by Courtland L. Bovee, John V. Thill& Barbara E. Schatzman.
3. Effective Business Communication by Herta A. Murphy, Herbert W. Hildebrandt & Jane P. Thomas.
4. Business Presentation by Lani Arrendondo.

HU-212 CIVICS AND COMMUNITY ENGAGEMENT

(Subject to the changes as defined by the concerned department).

The course has been designed to provide students with the fundamental knowledge of civics, citizenship, and community engagement. The course aims at teaching the undergraduate students about the essentials of civil society, government, civic responsibilities, inclusivity, and effective strategies for actively influencing and shaping society. It will help them apply theoretical knowledge to real-world situations and make a positive impact on their communities.

- Introduction to Civics and Community
- Introduction to Citizenship
- State, Government, and Civil Society
- Rights of Pakistani
- Sustainable Development Goals, Social Issues and Media
- Civic Responsibilities/Duties
- Community Engagement and Approaches to Effective Community Engagement
- Advocacy and Activism
- Digital Citizenship and Technology
- socioeconomic, geographic, etc. and their impact on citizenship
- Environment and Society Climate action
- Diversity Inclusion and Social Justice
- societal harmony and peaceful co-existence

RECOMMENDED BOOKS:

1. Krista M. Soria, Tania D. Mitchell (Eds.). Civic Engagement and Community Service at Research Universities: Engaging Undergraduates for Social Justice, Social Change and Responsible Citizenship. Palgrave Macmillan UK, 2016.
2. Will Kymlicka and Wayne Norman (Eds.), Citizenship in Diverse Societies, Oxford-New York, Oxford University Press, 2000.
3. Christine M. Cress; Peter J. Collier; Vicki L. Reitenauer. Learning Through Serving: A Student Guidebook for Service-Learning and Civic Engagement Across Academic Disciplines and Cultural Communities. Taylor & Francis, 2023.
4. Carole Cox, Tina Maschi. Human Rights and Social Justice: Key Issues and Vulnerable Populations. Routledge, 2022.
5. Muslim Volunteering in the West: Between Islamic Ethos and Citizenship. Springer International, 2020

HU-200 TECHNICAL REPORT WRITING

(Subject to the changes as defined by the concerned department)

The course has been designed to teach students how to adapt their writing to different audiences and purposes. It will help learners develop strategies for making subjects clear to readers who need to understand them. Through this course, learners will learn to write in a clear and concise style, present information logically, and design documents in which format contributes to clarity and efficiency.

- Introduction Technical Communication
- Making Writing Effective, Understanding the Writing Process
- Paragraph Writing
- Business correspondence
- Interview Skills
- Writing Technical Reports
- Types of Reports, Parts of a Formal Technical Report, and Research Report
- Understanding the difference between formal and informal reports.
- Writing, publishing, and presenting reports.

RECOMMENDED BOOKS:

1. Raymond V. Lesikar & Marie E. Flatley. Basic Business Communication. McGraw-Hill/Irwin [2001].

2. Sharon J. Gerson & Steven M. Gerson. Technical Communication: Process and Product. Boston: Pearson Inc. [2017].
3. Suzan Last; Candice Neveu & Monika Smith. Technical Writing Essentials: Introduction to Professional Communications in the Technical Fields. [2019]
4. Andrea J. Rutherfoord. Basic Communication Skills for Technology. Pearson [2000].

IS-102 ISLAMIC STUDIES

(Subject to the changes as defined by the concerned department)

QUR'ĀN AND SUNNAH

1) Al-Qur'ān Al Karim

1. Significance of The Holy Qur'ān

II) Compilation of The Holy Qur'ān

1. Textual Study of **Sura Al-Hujurat** (Complete)
   (Meanings of Arabic text, translation & explanation)

Sura Al-Hujurat

Focus: Impact of the teachings and commands mentioned in Sura Al-Hujurat on human life.

Main Points of discussion

1. Commands of Allah regarding meeting with the Holy Prophet peace be upon him.
2. Reports from wicked person to be tested.
3. Brotherhood, equality, effort to compose the quarrels of groups and reconciliate between them.
4. Elimination of social evils such as to laugh at people in contempt, calling others by offensive nick names, suspicion and back-biting.
5. All people (mankind) are one and the most righteous gets most honour before Allah.
6. Qualities of believers.
7. Knowledge of Allah about the secrets of the heavens and the earth and our actions.

Sura Al-Maida

Textual study of Surah Al-Maida (Verses:1 to 26)
(Meanings of Arabic text, translation & explanation)

Focus: Impact of the teachings and commands mentioned in sura Al-Maida on human life.

Main Points of discussion:

1. Stress on fulfillment of uqud (obligations)
2. Concept of Halal (lawful) and haram (forbidden) in Islam

3. Halal and haram animals and food
4. Symbols of Allah
5. Emphasis on helping one another in righteousness and piety
6. Rules of hunting the animals for food
7. Social relationship with non Muslims
8. Relationship between Muslims and Ah'l Al-Kitab (people of the Book)
9. Rules of purity and cleanliness
10. Allah's command to do justice and act righteously
11. The Covenant of Bani-Israel (The children of Isreal) with Allah and breach of their covenant
12. Allah's address to Ah'l Al-Kitab (people of the Book)
13. Address of prophet Moses (peace be upon him) to his people.

Textual Study of Sura **Al-Fur'qan:** verses: 63 to 77

(Meanings of Arabic text, translation & explanation)

Focus: Impact of the teachings and commands mentioned in Sura Al-Fur'qan on human life.

Main Points of discussion:

Characteristics of Ibad-ur-Rehman (Slaves of Allah)

1. Miracles (Ijaz) of the Holy Qur'ān
2. Principle of interpretation (Tafseer)
3. Textual Study of the Holy Qur'ān.

Surah Luqman (Meanings of Arabic text, translation & explanation)

Focus: Impact of the teachings and commands mentioned in Surah Luqman on human life.

Main points of discussion:

1. Characteristics of the righteous people (Al-Mohsineen) and their reward
2. Explanation of Lah wal Hadith and torment for its buyer
3. Universal logical arguments on Allah as the Creator
4. Conquering the Universe
5. Advices of Luqman to his son: not to associate anyone with Allah, to establish Salat, (prayer) enjoin good, forbid evil, bear the difficulties, not to speak to others with your face turned away, not to walk proudly and lower your voice
6. Orders of Allah to recognize the rights of parents
7. Amr-Bill Maruf and Nahi Anil Munkar, Need, importance and methods of Preaching Characteristics of a Preacher

8. Allah has subjected to man everything in the earth and the heavens and bestowed on him all His favour
9. Punishments for a disbeliever
10. Stress on fear of Allah the Lord and the Judgment Day
11. Knowledge of Allah

Surah Al-Noor

with Al-Baqra: 178, 179, Al-Nisa: 92,93, Al-Maidah: 8, 31-34,38, Al-Noor: 2-6, 27-29, 31,60, Al-Ahzab: 32,33,53,55,59 (Subjective study of the Sura)

Focus: Impact of the teachings and commands mentioned in surah Al-Noor on human life.

Main Points of discussion:

1. Introduction to the criminal law of Islam, concept of crime and punishment.
2. Classification of crimes in Islamic Criminal Law: Hudood and Tazirat.
3. Hudood: Zina (adultery, fornication),
4. Qad'f (false accusation),
5. Li'ān (accusation of a wife of zina),
6. Drinking intoxicating liquors, narcotics.
7. theft, Dacoity, Robbery, Murder, Apostasy and Rebellion.
8. If'k story (slander)
9. Privacy, Hijab (woman's veil)

2) Al-Hadith Al-Sharif

1. The need & Importance of Hadith
2. Textual study of Hadith: Arbaeen-e-Navavi by Imam Nawawi, Hadith: 1 to 21
   (Meanings of Arabic text, translations and explanation.)

Focus: Impact of teaching and commands mentioned in Ahadith on human life.

Main points of discussion:

1. Importance of intention (Niyya) in human actions
2. Islam, Iman (belief), Ihsan (excellence) and the Hour.
3. Rejection of Innovation (Al-Bid'ah) in religion (Din)
4. Lawful, unlawful and doubtful matters
5. Sincerity to Allah, His Books, His Messengers, leaders of the Muslims and common people
6. Protection of lives and property of people
7. Obedience of the Holy Prophet peace be upon him

8. Importance of lawful food, drink, clothing and nourishing
9. True believer is who likes for his brother what he likes for himself
10. Honour of the blood of Muslim and others
11. Respect of neighbors' and guests
12. Importance of good talk and silence
13. Prohibition to become angry and furious
14. Ihsan (excellence) with regards to everything
15. Good behavior towards people
16. All kinds of expectation, help and benefit from Allah
17. Importance of modesty (Al-Hiya)
18. To stand firm on Islam

3- Textual study of Hadith:
Bulugh-ul-Maram. Kitab-ul-Jami (Bab-ul-Adab, Bab-ul-Bir Wa Sela
(Meanings of Arabic text, translation and explanation)

Focus: Impact of teachings and commands mentioned in Ahadith on human life.

Main points of discussion:

1-Bab-ul-Adab: (Good Behavior)

1. Obligations on a Muslim for a Muslim
2. Golden principal to and lead a satisfied life and to control one's greed
3. What is righteousness? What is sin?
4. Emphasis on the respect of human sentiments
5. Social manners
6. Awareness of a meal blessed with auspiciousness
7. Manners of salam and greeting Muslims and non-Muslims
8. Manners regarding sneeze, eating, drinking, wearing cloths, putting on and off shoes and walking with shoes
9. Restriction of trailing garments arrogantly
10. Restriction of overspending

2-Bab-ul-Bir Wa Sila: (Kindness and joining the ties of relationship)

1. Golden principal for expansion of one's provision and an increase in life span
2. Prohibition to sever ties of relationship
3. Unlawful to be undutiful to mothers, to bury daughters alive, to refuse others and to demand from others.
4. Hatred actions

5. Pleasure and displeasure of Allah result form pleasure and displeasure of parents
6. Rights of neighbours
7. Most serious sins
8. Prohibition of reviling parents
9. Prohibition for a Muslim to avoid his brother
10. Importance of any miner act of goodness
11. Importance of help provided for others
12. Reward of concealing the faults of others
13. Re-compensation of kindness from others

3) Den-e-Islam, The study of basic articles of faith

Focus: Impact of basic articles of faith on human life.

Main points of discussion:

1. Tawheed: Fundamentals and types of Tawheed,
2. Prophet-hood and Finality of Prophet-hood,
3. The Day of Judgment

Pillars of Islam; Shahada, Salat, Saum, Zakat, Hajj and Jihad

Focus: Impact of Shahada, Salat, Saum, Zakat, Hajj and Jihad on human life.

Main points of discussion:

1. **Shahada** (Witness) Importance and philosophy of witness that no God but Allah and Muhammad (peace be upon him) is His Messenger.
2. **Salat** (Prayer) Imposition of prayer, orders and significance.
3. **Saum** (Fasting) Meaning of Fasting obligation of Fasting, significance, disbursement, physical and spiritual advantages.
4. **Zakāt:** The Economic system of Islam, Importance of Zakāt, Prohibition of Riba (Interest). Comparison between Islamic Economic system and socialism, Capitalism & Communism,
5. **Hajj:** Imposition of Hajj, commands and rites of Hajj, financial social and spiritual advantages of Hajj.
6. **Jihad** (Striving in the cause of Allah)**:** Importance, significance and its kinds:
    a. Against one's soul: to control its ego and desires (The greatest Jihad)
    b. Against ignorance
    c. Against Satan,
    d. Against the enemy
    e. Against disbelievers by the Holy Qur'an etc.

4) Seera-tun-Nabi

Life of The Holy Prophet (Peace be upon him) from prophet-hood to Hijra

Focus: Impact of the study of life of the Holy Prophet peace to upon him, on human life.

Main points of discussion:

4. First revelation
5. Message of the Holy Prophet peace be upon him to the people
6. Difficulties in preaching Islam in Makka and opposition of Quresh.
7. Reasons of hijra (migration) to Madina and impact of this migration

Focus: Impact of the life of the Holy Prophet peace be upon him on human life.

Main points of discussion:

1. Life of the Holy Prophet (Peace be upon him) at Madina, Madina Pact
2. The Holy Prophet (Peace be upon him) as a Perfect Man.
3. Mohammedan Revolution.

5) Islam and Modern Science

Focus: Impact of the teaching regarding Modern Science on human life.

Main points of discussion:

1. The Holy Qur'ān as s guide for the modern scientific development, Surah Al-Baqra: verse164, Aal-e-Imran: verses 190-191
2. Importance of science education in the modern age
3. Introduction of Muslim scientists, contribution of Muslim Scholars towards science

6) Ethics

Focus: Impact of the ethics on human life.

Definition, importance and significance of Ethics

Concept of Ethics in the light of Holy Qur'ān

Al-Baqra : 83, 169	Al-Ana'am : 151,152,153	Al-Tauba : 7
Yunus : 36	Hood : 18	Al-Nah'l : 112
Al-Mutaffefeen: 1,2,3		

Main points of discussion:

1. Kindness with parents, kindred, orphans and needy people.
2. Fair speaking to the people.
3. Refrain from evil and shameful deeds

4. Abstain from killing any person except by way of law
5. Security of the orphan's property
6. Full justice in measure and weight
7. Prevention from inventing a lie
8. Fraud and its bad effects.

Moral values in the light of Hadith

Bulugh-ul-Maram, Kitab-ul-Jamae, Babul Tarheeb Min Msavi-al-Akhlaq

Ahadith No.3, 4,7,14,17

Main points of discussion:

1. To control anger
2. Oppression is darkness
3. Telling a lie is sign of hypocracy
4. Backbiting
5. **Ethics and character building in the light of Seerah**

Ethical behaviour of the Holy Prophet (PBUH)

Significance of moral values

i) Truth (ii) Honesty (iii) Taqwa

(iv) Brotherhood (v) Patience

6. **Comparative Religious Morals**

1. (i)Hinduism (ii) Buddhism (iii) Judaism

(iv) Christianity (v) Islam

2. Philosophy of Ethics in revealed and non-revealed religions: an analysis.

Focus: Impact of ethics on human life.

Main points of discussion:

(a) **1. Ethics and Religion**

i. **Ethical behavior of the Prophets**

ii. Impact of belief on Ethics.

iii. Concept of worship and manners/ social relations in religion and their

1. impact on ethics

(b) **2. Ethics and character building, significance of moral values**

iv. Charity, Tolerance, Simplicity, Respect of mankind

v. Social Etiquettes of meetings, eating & drinking and conversation, Right of people.

Verses of the Holy Qur'ān about Ethics

Aal-e-Imran: 112 Al-Nisa: 43, 90, 91 Al-Aa‘raf: 35 Al-Ra‘d: 30
Al-Nah’l: 90, 91 Bani IsrailI: 29-37 Al-Fat’h: 26

Main points of discussion:

Purity and cleanliness Nourishing of peace liberality to kith and kin fulfillment of contracts condemnation of misery negligence from the signs of Allah, trust in Allah

Moral values in the light of Hadith:

vi. Bulugh-ul-Maram, Babul Zoh’d wal Wara’, Ahadith 2,6
vii. Babul Tarheeb Min Msavi Al-Akhlaq: Ahadith No.1,6,9

Main points of discussion:

Misery Worldly desires Avoid envy Showing of good deeds.
Insulting and abusing others

IS-202 IDEOLOGY AND CONSTITUTION OF PAKISTAN

(Subject to the changes as defined by the concerned department)

1. **Ideology of Pakistan**.
   i) Definition & Explanation.
   ii) Aims & objectives of Formation of Pakistan.
   iii) Ideology of Pakistan in the light of the sayings and speeches of Allama Iqbal and Quaid-e-Azam
2. **A Brief History of Muslim Society in Subcontinent**
3. The arrival of Muhammad Bin Qasim.
4. Muslim rule in Subcontinent.
5. The downfall of Muslim Rules and renaissance of Muslim rule in Sub-Continent.
6. **Historical background of the Ideology of Pakistan, National & Reformative Movements.**
   a. Sheikh Mujaddad Alf-I-Sani.
   b. ShahWali Ullah.
   c. Syed Ahmad Shaeed

   Sheikh Mujaddad Alf-I-Sani
7. Biography, Social & Religious Services,
8. Efforts against non Islamic Fundamentals.
9. Effects of the Movement.

   Shah Wali Ullah
1. Biography

2. Efforts Against non-Islamic fundamentals.
3. Reforms, social and religious services.

Sayyed Ahmad Shaheed

1. Biography
2. Jihad against Sikhs,
3. Opposition from Afghan tribes
4. Martyrdom at Balakot.

10. **Educational Efforts.**

1. Services of Sir Syed Ahmad Khan (Aligarh movement)
2. Political aspects of Alighar Movement
3. Educational services of Alighar Movement
4. Impact of Alighar Movement

11. **Pakistan Movement**

1. Muslim Nationalism:
2. Evolution of Two-Nation Theory.
3. Independence of India & Muslims
4. Khilafat Movement and Non-Cooperation Movement
5. Role of Ali Brothers and Mr. Gandhi
6. Presidential Address of Allama Iqbal at Allah Abad in 1930
7. 1937 Elections. Congress behavior.
8. Pakistan Resolution 1940.
9. To safeguard the ideological state in present era

Formation of Pakistan

1. Role of Scholars & Mashaikh, Students and Women, Journalists in the formation of Pakistan
2. Contribution of Non-Muslim leaders in the struggle of Pakistan
3. Initial Difficulties after Formation of Pakistan
4. Anti-Muslim riots in India:
5. Canal Water and distribution of Assets
6. Accession of States: Junagarh & Kashmir, its background and danger for the peace of South Asia.

The Land of Pakistan

1. Geographical importance
2. Pak-China economic corridor

3. Agricultural and industrial resources
4. Man Power & Education.

Efforts for implementation of Islamic System in Pakistan

1. Objectives Resolution 1949
2. Islamic provisions of the Constitutions of 1956,1962 &1973.
3. Process of Islamization during Zia era.

Foreign Policy of Pakistan

1. Determinants and principles of Pakistan foreign policy
2. Importance of Pakistan in Muslim World.
3. Pakistan and international organizations: UN, OIC, SAARC, ECO & SCO
4. Economic and defensive planning (Nuclear Policy)

MA-123 CALCULUS

(Subject to the changes as defined by the concerned department)

A review of differentiation: Geometrical interpretation of a derivative; Infinitesimal; Differential coefficient; Derivatives of higher order; Indeterminate forms and L. Hopital's; Asymptotes; Curvature; Approximation and error estimates.

Further techniques of integration; Integration by reduction formula; Fundamental Theorem of integral Calculus; Definite integral and its properties; Area enclosed between curves; Arc length; Volume of a solid; Volume of a solid revolution; Area of surface of revolution; Moments; Centroids. Improper Integrals; Infinite series

RECOMMENDED BOOKS:

1. Thomas' Calculus, Joel R. Hass, Christopher E. Heil, 14th edition, Pearson, 2017, **ISBN**: 978-0134438986
2. Calculus, Howard Anton, Irl C. Bivens, 10th Edition, 2012, John Wiley **ISBN**: 978-8126556403.
3. Calculus, E. Swokowski.

MA-129 VECTOR AND COMPLEX ANALYSIS

(Subject to the changes as defined by the concerned department)

A review of vector algebra, scalar and vector products; Scalar triple product; Vector triple product; Scalar and vector point functions; Differentiation and integration of vector point functions; Gradient of a function; Divergence, curl and their physical interpretations; Green's theorem in the plane; Gauss' divergence theorem and Stock's theorem; Cartesian tensors.

Polar and exponential forms of complex numbers; Product and quotient of complex numbers in polar form; Properties of complex numbers; Lograthim of a complex number; De Moivres Theorem, The *n*th roots of a number; Solution of equations; Circular and hyperbolic functions; Inverse hyperbolic functions; Limit, continuity and differentiability of complex functions; Analytic functions, Harmonic functions; Cauchy fundamental theorem and its consequences; Cauchy Integral formula; Derivatives of an analytic function; Singularities and calculus of residues; Contour integration.

RECOMMENDED BOOKS:

1. "Mathematics for Engineers and Scientists" by Muhammad Iqbal Bhatti and Muhammad Nasir Ch, published by Allied Book Centre, Urdu Bazar Lahore.
2. "Advanced Engineering Mathematics" by E. Kreyszig, published by John Wiley & Sons,
3. "Vector Analysis" by M.R. Spiegel, McGraw – Hill Book Company.
4. "Elements of Complex Variables" by Pennisi, L. L. Holt, Rinehart and Winston, U.S.A.
5. "Vector and Tensor Analysis" by N.A. Shah, A–One Publishers, Urdu Bazar, Lahore.

MA- 225 DIFFERENTIAL EQUATIONS AND TRANSFORMS

(Subject to the changes as defined by the concerned department)

Formation of differential equations; Solution of various types of first order differential equations; Orthogonal trajectories, Application in physical problems. Linear differential equations of second order, Complementary function and particular integral. Solution of non-homogeneous linear differential equations of second order and higher by (i) the method of undetermined coefficients (ii) the method of variation of parameters Application of second order differential equations; System of differential equations.

Formation of partial differential equations; Equations reducible to ordinary differential equations. Equations of the form $Pp + Qq = R$; Solution by the method of separation of variables. Wave, heat and Laplace equations.

Introduction to Laplace transform: Laplace transform of elementary functions, Laplace transform theorems, Inverse Laplace transform, applications to the solutions of initial value problems, Convolution theorem and applications.

Periodic functions, Even and odd functions. Fourier series of functions of period 2π and arbitrary period; Half range series. Complex Fourier series, Fourier transform and applications.

RECOMMENDED BOOKS:

1. "Mathematics for Engineers and Scientists" by Muhammad Iqbal Bhatti and Muhammad Nasir Ch., published by Allied Book Centre, Urdu Bazar Lahore.

2. "Advanced Engineering Mathematics" by E. Kreyszig, published by John Wiley & Sons.
3. Elementary Differential Equations and Boundary Value Problems, by Boyce and Diprima, 10th Edition, Wiley, 2012
4. "Advanced Engineering Mathematics" by H.K. Dass, published by S. Chand & Company, New Delhi.
5. "Ordinary Differential Equations" by N.A. Shah, A-one publishers, Urdu Bazar, Lahore.

MA-240 NUMERICAL ANALYSIS

(Subject to the changes as defined by the concerned department)

1. Solution of non-linear equations: Open methods, bracketing methods for locating roots, initial approximation and convergence criteria, Newton Raphson and Secant methods.
2. Solution of linear simultaneous equations: Jacobi's method; Gauss-Seidle method;
3. Finite differences: Difference operators and tables; Differences of polynomials;
4. Interpolation and polynomial approximation: Taylor series approximation, introduction to interpolation, Newton's polynomials, Newton's divided difference table and interpolation, Lagrange's interpolation, Chebyshev polynomials.
5. Numerical differentiation: approximating the derivative.
6. Numerical integration: Introduction to quadrature, trapezoidal, composite trapezoidal and Simpson's rules.
7. Solution of partial differential equations: Hyperbolic Equations, Parabolic Equations, Elliptic equations.
8. Computations: Numerical techniques in context of engineering applications and solutions of problems by using Matlab.

RECOMMENDED BOOKS:

1. "Numerical Methods for Engineers" by S. C Chapra & R. P Canale, McGraw-Hill.
2. "Numerical Methods using MATLAB" by John H. Mathews, Pearson Education.
3. "Applied Numerical Methods for Engineers using MATLAB" by Robert J. Schilling & Sandra L. Harris, Brooks/Cole.
4. "Numerical Methods for Engineers and Scientists" by D. Joe Hoffman.

LAB OUTLINES

As described by the department concerned.

MGT-349 ENTREPRENEURSHIP

(Subject to the changes as defined by the concerned department)

The course aims to provide the necessary theoretical and practical knowledge for establishing and managing small business. This includes various functions that an entrepreneur performs to ensure growth of small business.

The Foundations of Entrepreneurship, The Driving Forces behind Small Business, Starting from Scratch or Joining an Existing Business, choosing a Form of Ownership, The Business Plan: Visualizing the Dream, the business model, A Firm's Sources of Financing, Franchising and Buyouts, E-Commerce and the Entrepreneur, Building a New Venture Team and Planning for the Next Generation, Global Aspects of Entrepreneurship.

RECOMMENDED BOOKS:

1. Thomas W. Zimmer, Norman M. Scarborough and Doug Wilson, Essentials of Entrepreneurship and Small Business Management 5th Edition, Pearson
2. Robert D. Hisrich, Michael P. Peters and Dean A. Shepherd, Entrepreneurship, 5th Edition
3. Entrepreneurship _ successfully launching new ventures, Barringer and Ireland, Prentice Hall (2016)
4. Absolute Essentials of Business and Economics, Nerys Fuller-Love, Absolute Essentials of Entrepreneurship-Routledge (2020)
5. Essentials of Entrepreneurship and Small Business Management, Jeffrey R. Cornwall Norman M. Scarborough, Pearson (2018)
6. Entrepreneurship and Management in an Islamic Context, Veland Ramadani, Léo-Paul Dana, Shqipe Gërguri-Rashiti, Vanessa Ratten (eds.), Springer International Publishing (2017).

MGT-320 PROJECT MANAGEMENT IN ENGINEERING

(Subject to the changes as defined by the concerned department)

Introduction of Project Management; Challenges to Effective Project Management; Fundamentals of Project Management; Nine Knowledge Areas of Project Management; Project Management Process Groups; Project Management Life Cycles; Project Scope Planning; Project Planning; Project Launching; Project Monitoring and Controlling; Project Management Infrastructure; Project Portfolio Management; Continuous Process Improvement.

RECOMMENDED BOOKS:

1. Robert, K. Wysocki (2013). Effective Project Management: Traditional, Agile, Extreme. (7th Edition). Wiley.

2. Pmbok Guide (2021). A Guide to The Project Management Body of Knowledge. (7th Edition). Pmi.

Phy-115 APPLIED PHYSICS

(Subject to the changes as defined by the concerned department)

Electrodynamics: Electric field & its measurement, Gauss's Law, Applications of Gauss's Law, Magnetic field, Ampere's Law, Faraday's law, Lenz's Law, Eddy currents, Maxwell's equations, electromagnetic wave, Electromagnetic spectrum.

Waves & Oscillations: Sound Waves, Interference, Diffraction, Snell's Law, Doppler's Effect for sound and light. Ultrasonic waves, X-ray Diffraction (XRD.

Atomic and Nuclear Physics: Structure of atom, Types of Atomic Spectra, the laser, X-ray production and scattering, nuclear properties of atom, Radiations from nucleus, Laws of Radioactive disintegration, nuclear reactors, neutron thermalization, radiation detectors, Interaction of rays and matter.

LAB OUTLINES

1. Ionization Potential of Mercury.
2. To study the state Characteristics of a transistor.
3. To find the value of H by tangent galvanometer.
4. To find the E/M of electron by deflection method.
5. To draw B-H curve of a given material.
6. To find the velocity of sound wave in different media.
7. To find the surface tension of a given liquid.
8. C.R.O. demonstration.

RECOMMENDED BOOKS:

1. Fundamentals of Physics, 10th edition by David Halliday, Robert Resnick, and Jearl Walker
2. University Physics. 7th edition by Zears, Zemansky and Young.
3. Physics for Scientists and Engineers with Modern Physics, 4th edition by Dougles C. Giancol.

QT-101 Translation of the Holy *Qur'ān* -I

(Subject to the changes as defined by the concerned department)

Aims and objectives:

1. To teach the students the Holy *Qur'ān* with translation only.

2. To teach the students translation of the Holy *Qur'ān* relevant to faith (*Imaniyāt*) & ethics (ایمانیات و اخلاقیات).
3. To make the students understand the call of the Holy *Qur'ān*, so that they may be able to practise accordingly and be successful in this world and the world hereafter consequently.

Course Learning Objectives (CLOs)

1- Explain and understand the meanings of the Holy *Qur'ān* through its translation.
2- Identify the teachings and the guidance of the Holy *Qur'ān* regarding faith (*Imaniyāt*) & ethics (ایمانیات و اخلاقیات).
3- Evaluate the call of the Holy *Qur'ān* on faith (*Imaniyāt*) & ethics (ایمانیات و اخلاقیات) and recognize them by trying to practise on them accordingly to become a dutiful Muslim.

Week wise Course Contents:

Week	Details
Week 1	Translation of Part (*Parah*) 1, first ½ portion
Week 2	Translation of Part (*Parah*) 1, second ½ portion
Week 3	Translation of Part (*Parah*) 2, first ½ portion
Week 4	Translation of Part (*Parah*) 2, second ½ portion
Week 5	Translation of Part (*Parah*) 3, first ½ portion
Week 6	Translation of Part (*Parah*) 3, second ½ portion
Week 7	Translation of Part (*Parah*) 4, first ½ portion
Week 8	Translation of Part (*Parah*) 4, second ½ portion
Week 9	**Mid semester exam**
Week 10	Translation of Part (*Parah*) 5, first ½ portion
Week 11	Translation of Part (*Parah*) 5, second ½ portion
Week 12	Translation of Part (*Parah*) 6, first ½ portion
Week 13	Translation of Part (*Parah*) 6, second ½ portion
Week 14	Translation of Part (*Parah*) 7, first ½ portion
Week 15	Translation of Part (*Parah*) 7, second ½ portion
Week 16	Translation of Part (*Parah*) 8, first ½ portion
Week 17	Translation of Part (*Parah*) 8, second ½ portion
Week 18	**End semester exam**

List of recommended translations of the Holy *Qur'ān:*

1. موضح القرآن شاہ عبدالقادر دہلوی 2. فتح القرآن فتح محمد جالندھری 3. ترجمہ قرآن مجید حافظ نذر احمد
4. آسان ترجمہ قرآن سید شبیر حسین کرم شاہ الازہری 5. احسن البیان مولانا محمد جونا گڑھی 6. ترجمہ ضیا القرآن پیر
7. آسان ترجمہ قرآن مولانا محمد تقی عثمانی دہلوی 8. ترجمہ قرآن مولانا اشرف تھانوی 9. کشف الرحمٰن مولانا احمد سعید
10. ترجمہ تبیان القرآن مولانا غلام رسول سعیدی 11. مصباح القرآن ڈاکٹر عبدالرحمٰن طاہر 12. معانی القرآن دارالسلام
13. ترجمہ قرآن سید ابو الاعلیٰ مودودی دہلوی 14.قرآن مجید ،لفظی ترجمہ ڈاکٹر فرحت ہاشمی 15.مقبول القرآن سید مقبول احمد
16- آسان ترجمہ قرآن محمد ظفر
17. The meaning of Glorious *Qur'ān* Marmaduke Pickthal
18. *Qur'ān* Translation English Abdullah Yousaf Ali
19. *Qur'ān* Translation English Dr. Mohammad Mahmood Ghali
20. *Qur'ān* Translation English Muhammad Asad

QT-201 Translation of the Holy *Qur'ān* – II

(Subject to the changes as defined by the concerned department)

Aims and objectives:

1. To teach the students the Holy *Qur'ān* with translation only.
2. To teach the students translation of the Holy *Qur'ān* relevant to the worship (*Ibadāt*) & ethics (عبادات و اخلاقیات)
3. To make the students understand the call of the Holy *Qur'ān*, so that they may be able to practise accordingly and be successful in this world and the world hereafter consequently.

Course Learning Objectives (CLOs)

1- Explain and understand the meanings of the Holy *Qur'ān* through its translation.
2- Identify the teachings and the guidance of the Holy *Qur'ān* regarding worship (*Ibadāt*) & ethics

(عبادات و اخلاقیات).

3- Evaluate the call of the Holy *Qur'ān* on worship (*Ibadāt*) & ethics (عبادات و اخلاقیات) and recognize them by trying to practise on them accordingly to become a dutiful Muslim.

Week wise Course Contents

Week	Details
Week 1	Translation of Part (*Parah*) 9, first ½ portion
Week 2	Translation of Part (*Parah*) 9, second ½ portion
Week 3	Translation of Part (*Parah*) 10, first ½ portion
Week 4	Translation of Part (*Parah*) 10, second ½ portion
Week 5	Translation of Part (*Parah*) 11, first ½ portion
Week 6	Translation of Part (*Parah*) 11, second ½ portion
Week 7	Translation of Part (*Parah*) 12, first ½ portion
Week 8	Translation of Part (*Parah*) 12, second ½ portion
Week 9	**Mid Semester Exam**
Week 10	Translation of Part (*Parah*) 13, first ½ portion
Week 11	Translation of Part (*Parah*) 13, second ½ portion
Week 12	Translation of Part (*Parah*) 14, first ½ portion
Week 13	Translation of Part (*Parah*) 14, second ½ portion
Week 14	Translation of Part (*Parah*) 15, first ½ portion
Week 15	Translation of Part (*Parah*) 15, second ½ portion
Week 16	Translation of Part (*Parah*) 16, first ½ portion
Week 17	Translation of Part (*Parah*) 16, second ½ portion
Week 18	**End Semester Exam**

List of recommended translations of the Holy *Qur'ān:*

1. موضح القرآن شاہ عبدالقادر دہلوی
2. فتح القرآن فتح محمد جالندھری
3. ترجمہ قرآن مجید حافظ نذر احمد
4. آسان ترجمہ قرآن سید شبیر حسین کرم شاہ الازہری
5. احسن البیان مولانا محمد جونا گڑھی
6. ترجمہ ضیا القرآن پیر
7. آسان ترجمہ قرآن مولانا محمد تقی عثمانی دہلوی
8. ترجمہ قرآن مولانا اشرف تھانوی
9. کشف الرحمٰن مولانا احمد سعید
10. ترجمہ تبیان القرآن مولانا غلام رسول سعیدی
11. مصباح القرآن ڈاکٹر عبدالرحمٰن طاہر
12. معانی القرآن دارالسلام
13. ترجمہ قرآن سید ابو الاعلیٰ مودودی دہلوی
14. قرآن مجید،لفظی ترجمہ ڈاکٹر فرحت ہاشمی
15. مقبول القرآن سید مقبول احمد
16. آسان ترجمہ قرآن محمد ظفر
17. The meaning of Glorious *Qur'ān* Marmaduke Pickthal
18. *Qur'ān* Translation English Abdullah Yousaf Ali
19. *Qur'ān* Translation English Dr. Mohammad Mahmood Ghali
20. *Qur'ān* Translation English Muhammad Asad

QT-301 Translation of the Holy *Qur'ān* – III

(Subject to the changes as defined by the concerned department)

Aims and objectives:

1. To teach the students the Holy *Qur'ān* with translation only.
2. To teach the students translation of the Holy *Qur'ān* relevant to the Commands (*Ahkamāt*) & ethics (احکامات و اخلاقیات)
3. To make the students understand the call of the Holy *Qur'ān*, so that they may be able to practise accordingly and be successful in this world and the world hereafter consequently.

Course Learning Objectives (CLOs)

1. Explain and understand the meanings of the Holy *Qur'ān* through its translation.
2. Identify the teachings and the guidance of the Holy *Qur'ān* regarding the Commands (*Ahkamāt*) & ethics (احکامات و اخلاقیات).
3. Evaluate the call of the Holy *Qur'ān* on the Commands (*Ahkamāt*) & ethics (احکامات و اخلاقیات) and recognize them by trying to practise on them accordingly to become a dutiful Muslim.

Week wise Course Contents

Week	Details

Week 1	Translation of Part (*Parah*) 17, first ½ portion
Week 2	Translation of Part (*Parah*) 17, second ½ portion
Week 3	Translation of Part (*Parah*) 18, first ½ portion
Week 4	Translation of Part (*Parah*) 18, second ½ portion
Week 5	Translation of Part (*Parah*) 19, first ½ portion
Week 6	Translation of Part (*Parah*) 19, second ½ portion
Week 7	Translation of Part (*Parah*) 20, first ½ portion
Week 8	Translation of Part (*Parah*) 20,
Week 9	Mid Semester Exam
Week 10	Translation of Part (*Parah*) 21, first ½ portion
Week 11	Translation of Part (*Parah*) 21, second ½ portion
Week 12	Translation of Part (*Parah*) 22, first ½ portion
Week 13	Translation of Part (*Parah*) 22, second ½ portion
Week 14	Translation of Part (*Parah*) 23, first ½ portion
Week 15	Translation of Part (*Parah*) 23, second ½ portion
Week 16	Translation of Part (*Parah*) 24, first ½ portion
Week 17	Translation of Part (*Parah*) 24, second ½ portion
Week 18	End Semester Exam

List of recommended translations of the Holy *Qur'ān:*

1. موضح القرآن شاه عبدالقادر دہلوی 2. فتح القرآن فتح محمد جالندھری 3. ترجمہ قرآن مجید حافظ نذر احمد
4. آسان ترجمہ قرآن سید شبیر حسین کرم شاہ الازہری 5. احسن البیان مولانا محمد جونا گڑھی 6. ترجمہ ضیا القرآن پیر
7. آسان ترجمہ قرآن مولانا محمد تقی عثمانی دہلوی 8. ترجمہ قرآن مولانا اشرف تھانوی 9. کشف الرحمٰن مولانا احمد سعید
10. ترجمہ تبیان القرآن مولانا غلام رسول سعیدی 11. مصباح القرآن ڈاکٹر عبدالرحمٰن طاہر 12. معانی القرآن دارالسلام
13. ترجمہ قرآن سید ابو الاعلیٰ مودودی دہلوی 14.فہم القرآن،لفظی ترجمہ ڈاکٹر فرحت ہاشمی 15.مقبول القرآن سید مقبول احمد
16- آسان ترجمہ قرآن محمد ظفر
17. The meaning of Glorious *Qur'ān* Marmaduke Pickthal
18. *Qur'ān* Translation English Abdullah Yousaf Ali
19. *Qur'ān* Translation English Dr. Mohammad Mahmood Ghali
20. *Qur'ān* Translation English Muhammad Asad

QT-401 Translation of the Holy *Qur'ān* – II

(Subject to the changes as defined by the concerned department)

Aims and objectives:

1. To teach the students the Holy *Qur'ān* with translation only.
2. To teach the students translation of the Holy *Qur'ān* relevant to the dealings and affairs (*Muamalāt*) & ethics (معاملات واخلاقیات)
3. To make the students understand the call of the Holy *Qur'ān*, so that they may be able to practise accordingly and be successful in this world and the world hereafter consequently.

Course Learning Objectives (CLOs)

1. Explain and understand the meanings of the Holy *Qur'ān* through its translation.
2. Identify the teachings and the guidance of the Holy *Qur'ān* regarding the dealings and affairs (*Muamalāt*) & ethics (معاملات واخلاقیات).
3. Evaluate the call of the Holy *Qur'ān* on the dealings and affairs (*Muamalāt*) & ethics (معاملات واخلاقیات) and recognize them by trying to practise on them accordingly to become a dutiful Muslim.

Week wise Course Contents

Week	Details
Week 1	Translation of Part (*Parah*) 25, first ½ portion
Week 2	Translation of Part (*Parah*) 25, second ½ portion
Week 3	Translation of Part (*Parah*) 26, first ½ portion
Week 4	Translation of Part (*Parah*) 26, second ½ portion
Week 5	Translation of Part (*Parah*) 27, first ½ portion

Week 6	Translation of Part (*Parah*) 27, second ½ portion
Week 7	Translation of Part (*Parah*) 28, first ½ portion
Week 8	Translation of Part (*Parah*) 28, second ½ portion
Week 9	**Mid Semester Exam**
Week 10	Translation of Part (*Parah*) 29, first ¼ portion
Week 11	Translation of Part (*Parah*) 29, second ¼ portion
Week 12	Translation of Part (*Parah*) 29, third ¼ portion
Week 13	Translation of Part (*Parah*) 29, fourth ¼ portion
Week 14	Translation of Part (*Parah*) 30, first ¼ portion
Week 15	Translation of Part (*Parah*) 30, second ¼ portion
Week 16	Translation of Part (*Parah*) 30, third ¼ portion
Week 17	Translation of Part (*Parah*) 30, fourth ¼ portion
Week 18	**End Semester Exam**

List of recommended translations of the Holy *Qur'ān:*

1. موضح القرآن شاه عبدالقادر دہلوی 2. فتح القرآن فتح محمد جالندھری 3. ترجمہ قرآن مجید حافظ نذر احمد
4. آسان ترجمہ قرآن سید شبیر حسین 5. احسن البیان مولانا محمد جونا گڑھی 6. ترجمہ ضیا القرآن پیر کرم شاہ الازہری
7. آسان ترجمہ قرآن مولانا محمد تقی عثمانی 8. ترجمہ قرآن مولانا اشرف تھانوی 9. کشف الرحمٰن مولانا احمد سعید دہلوی
10. ترجمہ تبیان القرآن مولانا غلام رسول سعیدی 11. مصباح القرآن ڈاکٹر عبدالرحمٰن طاہر 12. معانی القرآن دارالسلام
13. ترجمہ قرآن سید ابو الاعلیٰ مودودی 14.فہم القرآن،لفظی ترجمہ ڈاکٹر فرحت ہاشمی 15.مقبول القرآن سید مقبول احمد دہلوی
16. آسان ترجمہ قرآن محمد ظفر
17. The meaning of Glorious *Qur'ān* Marmaduke Pickthal
18. *Qur'ān* Translation English Abdullah Yousaf Ali
19. *Qur'ān* Translation English Dr. Mohammad Mahmood Ghali
20. *Qur'ān* Translation English Muhammad Asad

CE-216 STRENGTH OF MATERIALS

(Subject to the changes as defined by the concerned department)

Important geometrical properties of plane areas, Introduction to forces, load transfer mechanism, resultant and reaction calculations, Bending moment and shear force diagrams for determinate beams for general loading. Principle of superposition, relationship between load, shear force and bending moment.

Types of stresses and strains, stress-strain behavior of ductile and brittle materials. Statically determinate and indeterminate problems, compound bars. Temperature stresses. Torsion of solid and hollow circular sections. Strain energy due to torsion and impact loads. Concept of bending and axial stresses in pipes.

LAB OUTLINES

1. Layout Plan of Strength of Materials Laboratory.
2. Study of small instruments.
3. To perform direct shear test on plain mild steel bar.
4. To perform punching shear test on plain mild steel bar.
5. To perform tension test on plain mild steel bar.
6. To perform compression test on wooden cubes, when load is applied:

i) Perpendicular to grain.

ii) Parallel to the grains.

7. To perform hardness test on mild steel and High Carbon steel specimen.
8. To perform bending test on wooden beam.
9. To verify the principal of super position by beam deflection.
10. To perform impact test on steel specimen:

i) In tension.

ii) In bending.

RECOMMENDED BOOKS:

1. Mechanics of Materials by Andrew Pytel 2nd Edition, 2011.
2. Mechanics of Materials by R.C. Hibbeler.
3. Mechanics of Engineering Materials by F.V. Warnock, P.P. Benham

CE-233 FLUID MECHANICS

(Subject to the changes as defined by the concerned department)

Introduction to fluid mechanics, hydrostatics, kinematics, hydrodynamics, hydraulics, solids and fluids, liquids and gases. Units and dimensions, physical properties of fluids, specific weight, specific volume, specific gravity, surface tension, compressibility, viscosity, newton's equation of viscosity.

Fluid Statics: pressure intensity and pressure head, pressure specific weight relationship, absolute and gage pressure, measurement of pressure, piezometer, Manometer, pressure transducer, differential manometer and bourdon gage. Forces on submerged plane and curved surfaces and their applications. Buoyancy and floatation, equilibrium of floating and submerged surfaces.

Fluid Kinematics: steady and unsteady flow, laminar and turbulent flow, uniform and non-uniform flow, path lines, stream lines and stream tubes, velocity and discharge, equation of continuity for compressible and incompressible fluids.

Hydro dynamics/Fluid dynamics: different forms of energy in a flowing liquid, head, Bernoulli's equation and its application, energy lines and hydraulic grade lines, free and forced vortex.

Flow Measurement: orifice meter, pitot tube and pitot static tube, venturimeter.

Steady flow through pipes: Darcy's Weisbach equation for flow in pipes, energy losses in pipelines, hydraulic grade lines and energy lines, pipes in series and parallel, transmission of energy through pipes, introduction to computer aided analysis of pipe network.

LAB OUTLINES:

Sr. No	Topics
1	To study the layout of Fluid Mechanics and Hydraulics lab.
2	Determination of various properties of fluid.
3	To measure head loss in a pipe of uniform diameter.
4	To determine the hydrostatic forces on a submerged plane and locate the position of center of pressure i.e. depth of center of pressure.
5	To investigate the validity of Bernoulli's equation when applied to a steady flow of water in a tapered duct.
6	To determine the coefficient of discharge for the horizontal venturimeter or for the calibration of venturimeter.
7	To determine coefficient of contraction (Cc), coefficient of velocity (Cv) and coefficient of discharge (Cd) of an orifice
8	To determine coefficient of discharge (Cd) of an orifice and hence to calibrate it.

RECOMMENDED BOOKS:

1. Fluid mechanics with Engineering Applications by Robert L. Daugherty, SI Edition
2. A textbook of fluid mechanics and hydraulic machines by Dr. R. K. Bansal
3. A textbook of Hydraulics, Fluid Mechanics and hydraulic machinery by R. S. Khurmi
4. Fluid Mechanics by J. F. Douglas

Ch. E-253 APPLIED THERMODYNAMICS

(Subject to the changes as defined by the concerned department)

1. Fundamental concepts in thermodynamics
2. First law of thermodynamics and its application for open and closed systems
3. Second law of thermodynamics and its applications for heat engines, refrigerators and heat pumps, entropy, and its significance.
4. Evaluation of thermodynamic properties of substances (PVT behavior and equations of states).
5. Heat effect: heat effects with and without phase change, calculation of entropy changes in processes.
6. Phase equilibrium: Degrees of freedom; Gibbs phase rule, criterion for phase equilibrium; Raoult's law and its applications, P-x,y and T-x,y diagrams; Bubble- and dew-point calculations

LAB OUTLINES:

As defined by the concerned department (who owns the subject).

RECOMMENDED BOOKS:

1. Applied Thermodynamics for Engineering Technologists, by A. Mc Conkey, T. D. Eastop, Pearson.
2. Process Heat Transfer, D.Q. Kern.
3. Surface Production Operation Volume-I, Design of Oil Handling Systems and Facilities by Ken Arnold & Manrice Stewart.

Ch. E-352 CHEMICAL TECHNOLOGY OF PETROLEUM

(Subject to the changes as defined by the concerned department)

1. History, occurrence, and recovery of petroleum — Origin, reservoirs, and reservoir fluids; Exploration, recovery, transportation, pretreatment methods.
2. Properties of petroleum and petroleum analysis methods.
3. Refining of petroleum — Atmospheric/ Vacuum distillation; Thermal/ catalytic cracking; Hydrotreating; reforming; desulfurization of petroleum products.
4. Petroleum-derived products — Polymeric materials.

LAB OUTLINES:

As defined by the concerned department (who owns the subject).

RECOMMENDED BOOKS:

1. Speight, J. G., The Chemistry and Technology of Petroleum. 5th ed.; CRC Press.
2. The Chemical Technology of Petroleum by William A Gruse and D. R. Stevens.
3. Petroleum Refinery Engineering by W.L. Nelson.

Ch. E-361 INSTRUMENTATION AND CONTROL

(Subject to the changes as defined by the concerned department)

1. Fundamentals of electrical technology and digital logic employed in measurement.
2. Review of scientific principles employed in instruments — Parts of instruments; Dynamics and static properties of instruments; Selection and calibration of instruments; Instrument identification and line symbols.

3. Available technology of instrumentation — Temperature; Flow; Level; Weight; Load; Pressure; Composition
4. Introduction and significance of process control
5. Design and hardware elements of a control system
6. Feed-forward and feed-back control structures.
7. Dynamics of first- and second-order systems
8. P, PI, and PID controllers
9. Routh's criterion and Bode plots

LAB OUTLINES:

As defined by the concerned department (who owns the subject).

RECOMMENDED BOOKS

1. Stephanopoulos, G., Chemical Process Control: An Introduction to Theory and Practice. Prentice Hall.

EE-201 ELECTRICAL ENGINEERING & ELECTRONICS

(Subject to the changes as defined by the concerned department)

Basics Concepts, Electrical and Units, Basic Circuits Laws and Measurements, Circuit Components, Multiple-Load Circuits, Complex-Circuit Analysis, Magnetism and Electromagnetism, Alternate Current and Voltage Power in AC Circuits, Capacitance, Inductance Transformers, R, C, and L Circuits, Electric Motors, Instruments and Measurements, Residential Wiring Concepts.

LAB OUTLINES

1.	Resistance Measurement by Color Code and its comparison with the Ohm-Meter Reading.
2.	Study of Ohm's Law
3.	Study and Proof of KCL
4.	Study and Proof of KVL
5.	Voltage Division Rule
6.	Current Division Rule
7.	Superposition Principle
8.	Study and Use of Oscilloscope
9.	RC Time Constants (Plot charging and discharging curves)

10.	RL Time Constants (Plot charging and discharging curves)
11.	To study resonance in an RLC circuit and find resonant frequency.
12.	To find power in a single phase AC circuit by one voltmeter ammeter method.
13.	To find power in a three phase AC circuit by two wattmeter method.
14.	Demo (Speed Control of DC Motor using Armature Voltage Control)
15.	Demo (Speed Control of DC Motor using Field Excitation Control)

RECOMMENDED BOOKS:

1. Electricity: Principles & Applications, By Richard Fowler, 8th Edition, Mc-Graw Hill.

IME-371 ENGINEERING ECONOMICS

(Subject to the changes as defined by the concerned department)

Introduction to Economics: Supply and demand theory, supply and demand equilibrium, micro- and macro-economic analysis

Engineering Economics: Principles of engineering economy, engineering economy methodology, steps in an engineering economic analysis.

Cost and Value Concepts: Sunk and opportunity costs, fixed, variable and incremental costs, recurring and non-recurring costs, direct, indirect and overhead costs, standard costs, cash versus book costs, life cycle costs, value, market value, use value, fair value, book value, salvage value, value addition.

Comparing alternatives: Net present value, Net present cost, Cost Benefit analysis, internal rate of return, payback period, levelized costs, break-even analysis applicable to capital investment

Depreciation: Types of depreciation, methods of computing depreciation, economic life of equipment and replacement decisions.

Product Costing: Sources of costing information: labor material, overheads, fixed cost, variable cost, absorption costing, marginal costing, standard costing.

RECOMMENDED BOOKS:

1. Engineering Economy by William G. Sullivan, Elin M. Wicks and C. Patrick Koelling, 16th Edition, Pearson Education, 2008. ***(Textbook)***
2. Basics of Engineering Economy by Leland Blank and Anthony Tarquin, 7th edition, McGraw-Hill publications, 2008.

ME-100L WORKSHOP PRACTICE

(Subject to the changes as defined by the concerned department)

1. Machine Shop: Detailed study of centre lathe and accessories. Plain and Taper turning. Basic lath operations including turning, facing, simple screw cutting/treading, knurling, Grooving (Drilling and Boring), cutting tools and their grinding. Brief Introduction of shaper, milling Sharing and Surface Grinding Machine. Assigning of Practical Jobs.

2. Fitting and Fabrication Shop: The use and care of fitter's tools. Marking out of job. Practice in Metal filing. Sawing, Drilling, dieing, Tapping and reaming. Brief introduction and use of power Hack Saw, Arbor Press, Sheet Sharing Machine, Sheet Rolling Machine, Punching Machine and Drilling Machine. Assigning of practical Jobs.

3. Carpentry Shop: The use and care of tools. Type of Timber, its defects and preservation methods practice in planning and sawing. Different types of wood joints. Study of sawing, planning, turning mortise and tenon machines. Assigning of Practical Jobs.

4. Electrical Shop: Electric shocks and treatment. The use and care of tools used by Electrician. Types and uses of cable and electrical accessories for house wiring, practice in simple house wiring, testing methods. Switch gear used on domestic installation and DB system. Earthing System. Assigning of Wiring arrangements practical.

RECOMMENDED BOOKS:

1. Workshop Technology Part-1 by W.A.J Chapman.
2. Electrical Wring by Richter and Schwan
3. Wiring Manual by Pak Cables Limited.

ME-120L ENGINEERING DRAWING & GRAPHICS

(Subject to the changes as defined by the concerned department)

Introduction: The course covers: Introduction to the subject use of instruments, Planning of a drawing sheet, the projector of simple solids simple position, and the oblique and auxiliary planes. Lettering and dimensioning the principal requirement of a working drawing. Isometric and pictorial projection of solid figures, making of freehand sketches from solid objects and from orthographic projection. Section of solids, riveted joints. Screw thread systems nut and bolt, keys and cotter, coupling and simple bearings. Pipe connections, engine detail.

RECOMMENDED BOOKS:

1. Fundamentals of Engineering Drawing by Warrem J. Luzjader.
2. Elementary Engineering by N.D. butt.

3. Elementary of Solid Geometry by M.K. Guna.
4. A first year Engineering Drawing by A.C. Parkinson.

Min-E-101 APPLIED GEOLOGY

(Subject to the changes as defined by the concerned department)

Introduction to various branches of geology, Origin of the earth and its place in universe, interior of the earth and chemical composition of the earth's crust, Mountain building and valley formation, drainage patterns and their types, agents of weathering and erosion, Deformational structural features of rocks, dip, strike, faults, folds, joints and fissures, unconformities etc. Introduction to continental drift and plate tectonics, earthquakes, and volcanism with special reference to Pakistan, Formation of rocks and minerals, classification of rocks, Occurrence of economic minerals and dimension stones of Pakistan.

LAB OUTLINES:

1. International geological symbols for rocks, structures and minerals
2. Measurement of dip and strike
3. Geological map reading
4. Moh's Scale Hardness
5. Identification of rock forming minerals
6. Study of wooden models of faults and folds etc.

RECOMMENDED BOOKS:

1. K. M. Banger, Text book of Geology
2. H. H. Read, Rutley's Mineralogy
3. Dana, Dana's Manual of Mineralogy
4. Santosh Kumar Grag, Text book of Geology
5. Raymond, L. A., The Study of Igneous, Sedimentary and Metamorphic Rocks, McGraw Hill.
6. Arthur Holmes and Dorris Holmes, Physical Geology
7. F. G. H. Blyth, Geology for Engineers

Min. E-359 SURVEYING AND LEVELLING

(Subject to the changes as defined by the concerned department)

1. **Fundamental Concepts:** Definitions, Uses & types of surveys, Units of Measurement., Main instruments and their accessories Accuracy and Precision, Errors and Mistakes, adjustments of errors.
2. **Measurement of Horizontal Distances:** Different Methods and instruments for distance measurement. Errors and mistakes in taping and their adjustments. Field notes for Taping, Conventional and Electronic Field Books.
3. **Leveling:** Different methods and instruments used for leveling. Effects of Curvature of earth and Refraction of atmosphere, Types of Levels, Errors in leveling and their adjustment. Differential, profile and Reciprocal Leveling.
4. **Angles and Directions:** Angles and Directions, Meridians and Azimuths, Bearing and their computation. Adjustments of Bearings, Types of Compasses.
5. **Surveying Operation**: Types of Theodolites, Measurement of Horizontal and Vertical Angles, Temporary and Permanent Adjustments. Plane Table Surveying. Transit Tape Traverse. Adjustment of Traverse. Computation of Rectangular Co-ordinates., Computation of Omitted Measurements, Area Computation of Closed Traverse. Topographic map, Contours and their characteristics. Different methods of Contouring.
6. **An Introduction to Geomatics and Global Positioning System:** Geomatics defined, Branches of Geomatics, GPS Surveying techniques

LAB OUTLINES:

1. To establish vertical control using differential leveling.
2. Distance measurement with taping
3. Traversing
    a. Plane table traverse
    b. Transit tape traverse
4. Basic operations of Hand-Held GPS receiver.
5. To locate the coordinates of Different building around Campus using Hand Held GPS.

RECOMMENDED BOOKS:

1. Elementary Surveying: An Introduction to Geomatics / Charles D. Ghilani, Paul R.Wolf. 13th Ed. (2012)
2. Surveying and Leveling by T. P. Kanetker, Published by: Pune Vidyarthi Griha Prakashan, 24th Ed. (2010).
3. Surveying Theory and Practice by Raymond Earl Davis, Francis Seeley Foote and William Horace Rayner. Published by: McGraw Hill, 3rd Ed. (1981)

Pet.E-101 FUNDAMENTALS OF PETROLEUM ENGINEERING

National and International energy requirements. Sources of energy. Role of Petroleum as an energy source. Brief history of International Petroleum industry. Influence of Petroleum on International politics. Highlights of local Petroleum industry. Job Scope of Petroleum engineering graduates.

Overview of Petroleum Engineering, Composition, physical properties, geological and geophysical prospecting, cable tool drilling, rotary drilling mechanisms, drilling fluids, formation evaluation, reservoir, and production engineering concepts.

RECOMMENDED BOOKS:

1. Introduction to Petroleum Engineering, John R. Fanchi, Richard L. Christainsen, John Wiley, **ISBN**: 978-1119193449
2. Petroleum Engineering: Drilling and Well Completions, Carl Gatlin, Prentice Hall, **ISBN:** 978-0136621553.
3. Debby Denehy, Fundamentals of Petroleum, 5th Edition, PETEX, **ISBN:** 978-0886982317
4. Properties of Petroleum Fluids, 3rd Edition, William D. McCain Jr., PennWell Books, **ISBN:** 978-1593703738

Pet. E-102 PETROLEUM GEOLOGY & GEOPHYSICS

Geological history of Petroleum, The origin, migration and accumulation of petroleum, Reservoirs with abnormal pressure and temperature. Geological distribution of petroleum in the world. Geological basins of Pakistan, Geology of existing oil and gas fields in Pakistan. Surface geological methods for petroleum exploration, Use of topography and surface features for oil prospecting.

Modes of deformation of rocks, parts, varieties, and formation of folds faults, etc. and expression of these features on geological field maps, Geological mapping, and the application of photogrammetry.

Geophysical exploration methods with emphasis on seismic methods and History of exploration in Pakistan. Overview of seismic reflection and refraction survey. Preparation of travel time curve

RECOMMENDED BOOKS:

1. Basic Exploration Geophysics, by E. S. Robinson, ISBN: 978-0-471-87941-1.
2. Geophysical Prospecting, by Milton, B. Dobrin, ASIN: B010WFNR98, 4th Edition.
3. Geology of petroleum, A.I. Levorsen. ASIN: B000H4RFY8.
4. Basic Petroleum Geology, Peter K. Link., ISBN-13: 978-0930972226, 3rd Edition.

5. Petroleum Geology of Pakistan, Iqbal B. Kadri. ASIN: B0006F6X1Y.

Pet. E-103L OCCUPATIONAL HEALTH AND SAFETY.

- Introduction to Occupational Health & Safety (OHS)
- OHS as a Behavior
- Health & Safety Standards
- Risks, Hazards & Their Classification
- Health & Safety Hazards in Upstream Petroleum Industry
    - Risks & Hazards During Drilling
    - Risks & Hazards During Production
- OHS Communication
    - Signs & Safety Symbols
    - Accident Reporting
- OHS Management: Proactive vs. Reactive
- Risk Assessment and Minimization
- Pakistan's OHS Regulatory Framework
- International Best Practices
- Risk factors associated with petroleum industry operations.

RECOMMENDED BOOKS:

1. Jeremy Stranks, The A-Z of Health and Safety, Thorogood, **ISBN**: 978-1854183873.
2. Charles D. Reese, Occupational Health and Safety Management 3rd Edition, Routledge, **ISBN:** 978-1138749573.
3. Phil Hughes MBE, Ed Ferrett, Introduction to Health and Safety at Work: for the NEBOSH National General Certificate in Occupational Health and Safety 6th Edition, Routledge, **ISBN:** 978-0415723084

Pet. E-151 MINI PROJECT-I

Project will be offered with reference to Petroleum & Gas Engineering, sustainable development, and future energy related to Sustainable Development Goals (SDGs). This project is offered to non-Muslim students in lieu of Translation of Holy Quran-I.

Pet. E-201 RESERVOIR GEOMECHANICS

1. Fundamentals and experimental rock mechanics
    a. Stress and strain analysis, mechanical deformation, strength and failure analysis.
2. Subsurface Stresses
    a. Principal earth stresses: principal and effective, regional and local stresses, overburden stress, horizontal stress orientation, borehole breakouts, drilling-induced tensile fractures, classification of faults.
    b. Concept and construction of the Mechanical Earth Model, data requirements and types of input data.
3. Wellbore geo-mechanics and wellbore stability
    a. State of stresses around the wellbore
    b. Modes of rock deformation around the wellbore
    c. Optimization of horizontal well trajectory based on stress regime.
4. Introduction to reservoir compaction. Geo-mechanical changes in the petrophysical properties. Introduction to geo-mechanical modeling

RECOMMENDED BOOKS:

1. E. Fjaer et al, “Petroleum Related Rock Mechanics”, Elsevier 2008.
2. Mark D. Zoback, “Reservoir Geo-mechanics” ist Edition.
3. Tarek Ahmed, “Reservoir Engineering Handbook” (fourth Edition) Elsevier ISBN: 978-1-85617-803-7.

Pet. E-203 PETROPHYSICS

Introduction to formation evaluation, core analysis. Fundamental properties of fluid permeated rocks; porosity, Permeability, fluid saturations, compressibility, surface kinetics. Relative Permeability and Capillary Pressure, Core sampling and preservation. Measurement of basic rock properties. Interpretation of basic core analysis data. Special rock properties; electrical, acoustic, thermal.

Application of core analysis data. Example calculations of petrophysical properties.

LAB OUTLINES:

1. To draw the layout plan of Petrophysics & Core laboratories
2. To determine the grain density of given core sample
3. To find the fluid saturation in the given core sample using modified ASTM Saturation Method.
4. To clean the given core sample using ASTM Extraction Methods.

5. To clean the given core sample using Soxhlet Extraction Methods.
6. To find the fluid saturation in the given core sample using Retort Oven.
7. To find the porosity of the given sample using Gravimetric Method.
8. To find the porosity of the given sample using Volumetric Method.
9. To calibrate Helium Porosimeter.
10. To measure the porosity of the given sample using Helium.
11. To measure the permeability of given Core sample using Gas Permeameter

RECOMMENDED BOOKS:

1. Petrophysics, Djebbar Tayyab, 4th Edition, Gulf Professional Publishing ISBN: 978-0128031889
2. Applied Petroleum Reservoir Engineering, B.C. Craft & M.F. Hawkins, Ronald E Terry, ISBN: 978-0130398840.
3. Fundamental of Reservoir Engineering, L.P. Dake, ISBN: 978-0444418302.
4. Petroleum Reservoir Engineering Physical Properties, James W. Amyx, ISBN: 0070016003.

Pet.E-204 DRILLING ENGINEERING-I

Purpose of drilling, types of Different Wells, planning the well. Rotary drilling-its introduction, Basic rig components and their function, mud pumps rating and capacities. Development in drilling system. Rotary drilling bits, Bit types, standard classification, selection, Dull Bit Grading, and evaluation. Introductions to drilling fluids, their function, general nature, and composition, types of drilling mud, mud additives, and mud calculations. Air, natural gas, and aerated mud used as drilling fluids, Calculation of air and horsepower requirements. hydrostatic heads of liquids, the hydrostatic heads of mud and cement slurries. Formation pressures and its types, pressure relations in the earth and bore hole total overburden pressure. Formation Pressure Measurement using Different Techniques, Drilling hazards and their remedies Underbalanced Drilling (UBD).

LAB OUTLINES

1. Layout of Drilling Engineering Laboratory.
2. Introduction of different Rig components model.
3. Density of Mud Determination using Mud Balance
4. Prepare a mud of known density.

5. To determine the Gel strength of a drilling mud.
6. To determine the Plastic viscosity, Apparent viscosity and Bigham Yield point and true yield point.
7. To determine the mud viscosity.
8. To determine mud cake formation capacity of different muds.
9. To study the filtration loss quality of a drilling mud.
10. To determine the clay/ sand contents of the drilling mud.
11. To determine the oil, water, solids, and clay content of the drilling mud
12. To determine API gravity, specific gravity of drilling mud

RECOMMENDED BOOKS:

1. Applied Drilling Engineering by Adam. T. Bourgoyne Jr., Keith. K. Millheim, SPE Textbook Series, Vol 2, ISBN: 978-1555630010, Society of Petroleum Engineers
2. Well Engineering and Construction by Hussain Rabia, ISBN: 978-0954108700, Entrac Consulting
3. Petroleum Well Construction by Michael J. Economides, Larry T. Watters, Shari Dunn-Norman, ISBN: 978-0471969389, John Wiley; 1st edition
4. Formulas and Calculations for Drilling, Production, and Workover: All the Formulas You Need to Solve Drilling and Production Problems by William C. Lyons, Thomas Carter, Norton J. Lapeyrouse, ISBN: 978-0128034170, Gulf Professional Publishing; 4th edition.

Pet. E-251 MINI PROJECT-II

Project will be offered with reference to Petroleum & Gas Engineering, sustainable development, and future energy related to Sustainable Development Goals (SDGs). This project is offered to non-Muslim students in lieu of Translation of Holy Quran-II.

Pet.E-301 GEO-ENERGY RESOURCES

Introduction to the rock's classifications and origin – Types of various geo-energy resources - Introduce to the fundamentals of the mineral resources generation - hydrocarbon origin, composition - geological principles and processes and relationships with hydrocarbons generation and accumulation processes - Thermodynamic behavior of hydrocarbon mixtures - Introduction of Geothermal Energy and its classification - Thermal Structure of the Earth - Heat Transport and Thermal Parameters - Exploration and Analysis - Subsurface Systems & design issues - Uses of Geothermal Energy - Types of Geothermal Power Plants for heat and

electricity generation - Enhanced Geothermal Systems (EGS) - Environmental issues related to deep geothermal systems.

Recommended Books:

1. Hyne N.J. (2001) Petroleum Geology, Exploration, Drilling and Production. Pennwell. ISBN 0-87814-823.
2. - Bustillo Revuelta M. (2018) Mineral Resources. Springer. DOI 10-1007/987-3-319-58760-8-4
3. Geothermal Energy. 2nd Edition by Ingrid Stober and Kurt Bucher; Springer Nature Switzerland AG 2021. https://doi.org/10.1007/978-3-030-71685-1.
4. The Future of Geothermal Energy. Idaho National Laboratory, Massachusetts Institute of Technology 2006. ISBN: 0-615-13438-6.
5. Thermo-Hydro-Mechanical (THM) coupled simulations of innovative enhanced geothermal systems for heat and electricity production as well as energy storage. By Muhammad Haris; Cuvillier Verlag Goettingen, ISBN-13: 9783736976603, 2022.

Pet.E-302 UNCONVENTIONAL RESERVOIRS

1. Introduction to Unconventional Energy Resources
    a. Economic Significance, technical, economic, political, and environmental constraints on development of unconventional resources.
2. Occurrences, resources, and reservoir characteristics
    a. Low-permeability (Tight) sands.
    b. Shale reservoirs (gas and oil).
    c. Coal Bed Methane (CBM).
    d. Gas Hydrates.
    e. Heavy oil.
3. Drilling and completion methods for unconventional reservoirs
4. Other unconventional energy resources
    a. Geothermal energy.
    b. Coal conversion to Gas.
    c. Coal-to-gas and In-situ gasification.
    d. Water and environmental issues.
    e. Natural fractures and their importance in unconventional resources.

5. Basic measurements for characterization of unconventional resources.

RECOMMENDED BOOKS:

1. Reza Rezaee, Fundamentals of Gas Shale Reservoirs", 2015.
2. Usman Ahmed and Nathan Meehan; Unconventional Oil and Gas Resources-Exploitation and Development, CRC Press, 2016, pp 860.
3. Ma and Holditch, "Unconventional Oil and Gas Resources Handbook: Evaluation and Development", 1st Edition, Elsevier, 2015.
4. A Guide to Coal-bed Methane Operation, Gas Research.

Pet.E-303 WELL COMPLETION

Basics of well completion, Considerations in well completion design, Types of well completion equipment including tubing, packers, liners, tubular goods, side sleeve doors, landing nipples, Wellhead, and trees. Open hole, cased hole, and liner completions. Completions for multistage stimulation treatments and perforation techniques.

RECOMMENDED BOOKS:

1-Advanced Well Completion Engineering Third Edition 2011 by Wan Renpu, ISBN 978-0-12-385868-9, Gulf Professional Publishing

2-Well Completion Design by Jonathan Bellarby, 1st Edition 2009, volume 56, Elsevier. ISBN: 978-0-444-53210-7, ISSN: 0376-7361

3- Well Completion and Servicing by Denis Perrin, Editions Technip, Paris 1999, Institut Francais Du Petrole Publications ISBN: 2-7108-0765-3 ISSN 1271-9048

4- Modern Completion Technology for Oil and Gas Wells by Ding Zhu and Kenji Furui Publisher McGraw Hill LLC, 2018 ISBN 1259642038, 9781259642036

Pet.E-304 OFFSHORE FIELD DEVELOPMENT

Overview of offshore oil and gas industry, Regulatory framework and environmental considerations, Exploration and Site Selection, Types of offshore structures, Conceptual design and feasibility studies, Fixed and floating platform design and installation, Offshore drilling and production operations, Subsea infrastructure and pipelines, Field Development Planning, Production optimization strategies, Asset integrity management, Decommissioning and abandonment planning, Deepwater and ultra-deepwater challenges.

RECOMMENDED BOOKS:

1- Handbook of Offshore Oil and Gas Operations by James G. Speight, 2011, Imprint Gulf Professional Publishing, Copyright Elsevier, ISBN 978-1-85617-558-6

2- Offshore Oil and Gas Development: Background and Issues by Jonathon C. Brady, Nova Science Publishers, Inc.; UK (January 8, 2013) ISBN : .1617288296-978

3- Subsea Engineering Handbook by Yong Bai and Qiang Bai, 2010, Imprint Gulf Professional Publishing, Copyright Elsevier. ISBN 978-1-85617-689-7

Pet.E-305 PRINCIPLES OF CORROSION CONTROL

1. Corrosion Principles
    a. Corrosion Mechanism causes corrosion cells.
    b. Polarization and factors of polarization.
    c. High temperature corrosion.
    d. Stress corrosion cracking (sulfide stress corrosion cracking, chloride stress corrosion cracking, caustic stress corrosion cracking, environmentally inducted cracking).
    e. Hydrogen damage.
    f. Corrosion losses.
2. Corrosion Control
    a. Corrosion detection methods (corrosion coupons, corrosion casing potential profile tool).
    b. Corrosion control methods (material selection environment modification, inhibitor treatment).
    c. Evaluation of inhibitor treatment program.
    d. Cathodic protection, properties of galvanic anodes, design of impressed current, G/B, Criteria of CP, interference, anodic protection.

RECOMMENDED BOOKS:

1. A.W. Peabody, "Control of Pipeline Corrosion", National Association of Corrosion Engineers, ISBN: 1575900920
2. Pierre R. Roberge, "Handbook of Corrosion Engineering", McGraw-Hill, **ASIN:** B0092J33H2
3. Mars Fontana, "Corrosion Engineering (Materials Science & Engineering)", 3rd Edition, McGraw-Hill Companies, ISBN: 0070214611.

Pet.E-311 WELL LOGGING AND INTERPRETATION

Basic Concepts: Logging environment, porosity, permeability, fluid saturations, formation density, resistivity, invasion process and resistivity profiles.

Electrical Logs: SP logs, conventional, normal, lateral, and micro devices.

Nuclear Logs: Gamma ray, neutron and formation density logs Sonic or acoustic log.

Cross plots of various logs.

Quantitative Analysis: Formation water resistivity and saturation determination. Lithology and porosity determination. interpretation of spontaneous potential log, gamma ray log, porosity logs, resistivity logs and magnetic resonance imaging log, to identify the rock and calculate its fluid properties.

CBL (cement bond log)/VDL (variable density log).

LAB OUTLINES:

1. Interpretation of different resistivity profiles.
2. Determination of formation temperature using well log data.
3. Determination of variation in different resistivity with a change in temperature.
4. Determination of formation water resistivity from spontaneous potential log.
5. Determination of corrected resistivity of flushed zone and un-invaded rock using Tornado charts.
6. Determination of shale volume using SP/gamma ray log data.
7. Determination of shale corrected porosity of the rock by using sonic log data.
8. Determination of lithology and porosity of the rocks using various cross plots

RECOMMENDED BOOKS:

1. Theory, Measurement & Interpretation of Well Logs by Zaki Bassiouni, SPE Textbook Series Vol.4, ISBN: 978-1-55563-056-0.
2. Open hole Log Analysis and Formation Evaluation by Richard M. Bateman, SPE Textbook Series, Second Edition, ISBN: 978-1-61399-156-5.
3. Cased Hole Log Interpretation, Principles/ Applications by Schlumberger.

Pet.E-312 PETROLEUM ECONOMICS & RISK MANAGEMENT

Introduction: Definition and some of the basic concepts. Profit Planning. Typical oil company objectives. The role of management in planning. Planning of capital expenditures. Some Basic Principles of Economics. Demand, supply, and equilibrium price. Crude oil price volatility Inflation. Uncertainty and Risk.

The Time Value of Money: The Concept of Interest. Simple and compound interest. Nominal and effective interest rate. Cash Flow Diagram. The Time Value of Money. Present value of the future sum. Future value of the present sum

Before-Tax Cash Flow Models: Cash Flow Model. Data Required for Project Evaluation. Forecasting Product Stream. Product Pricing. Capital Expenditures (CAPEX). Geological and geophysical (G&G) costs. Estimating drilling costs. Facility costs. Operating Expenditure (OPEX). Abandonment costs and sunk costs. Opportunity costs.

International Petroleum Economics (After-Tax Cash Flow Models): Types of Contract Arrangements. The concessionary system. Sample concessionary system cash flow spreadsheet. The production sharing system. Sample PSC cash flow spreadsheet. Rate of return (ROR) contracts. Effects of Various Fiscal Terms.

Capital Budgeting Techniques: Accounting Approaches. Payback period. The average return on investment (AROI). Discounted Cash Flow Approaches. Discounted payback period. Net present value (NPV). Internal rate of return (IRR). Profitability index (PI).

Project Decision & Risk Analysis: Handling of Uncertainty in Capital Investment. The Decision Analysis Cycle. Application of Decision Analysis. Typical Industry Risks. Descriptive Statistics. Mean, Median and Mode. Understanding Probability Concept. Rule of Probability.

RECOMMENDED BOOKS:

1. Project Economics & Decision Analysis, Volume I & II, ISBN: 978-0878148191 & II ISBN: 978-0878148558, M. A. Mian, Pennwell Books.
2. Economics of Worldwide Petroleum Production, Richard D. Seba. ISBN: 978-0930972219.
3. Engineering Economy, William G. Sullivan, Elin M. Wicks, C. Patrick Koelling, 16th Edition, Pearson Education Ltd. ISBN:978-0133439274.

Pet.E-314 RESERVOIR ENGINEERING

Fundamental reservoirs engineering, classification of reservoir flows system, geometry of the reservoir steady state and unsteady state flow, Darcy's law of fluid flow through porous media, Dimensional analysis of Darcy's law, Basic flow equations, Pressure distribution and pressure gradient for linear, radial, compressible, slightly compressible and incompressible steady state flow conditions. Determination of average pressure in radial flow system, Readjustment time, Productivity index, Specific productivity index and injectivity index, Relationship between well-bore radius and flow rate in radial flow system. Continuity equation and its derivation. Diffusivity equation and its different forms. Volumetric evaluation of oil in place and empirical reserve estimates. Different types of driving mechanism for hydrocarbon reservoirs.

RECOMMENDED BOOKS:

1. Applied Petroleum Reservoir Engineering, Ronald E. Terry, J. Brandon Rogers. ISBN: 978-0133155587

2. Reservoir Engineering Handbook, Tarek Ahmed PhD, **ISBN:** 978-1856178037
3. Fundamental Principles of Reservoir Engineering by Brian F. Towler, ISBN: 978-1555630928
4. Oil Reservoir Engineering, Sylvain Joseph Pirson, ISBN: 0882755005.
5. Fundamental of Reservoir Engineering, Ben H. Caudle, ASIN: B0007GPIIQ.
6. Reservoir Engineering Manual, Frank W. Cole, ASIN: B003AA4LKW.
7. Reservoir Engineering, the fundamentals, simulations and management of conventional and unconventional recoveries by Abdus Sattar and Ghulam M. Iqbal, Elsevier 2016, ISBN: 978-0-12-800219-3.

Pet.E-315 PETROLEUM PRODUCTION ENGINEERING-I

Introduction to Petroleum Production system; components and working principles, properties of oil and natural gas, Deliverability of oil and gas reservoir; various estimation models and their selection on the basis of flow regimes and pressure levels, deliverability of horizontal wells, Inflow Performance Relationship (IPR) models; straight line and curve IPR, time dependency of the IPR models, composite IPR of stratified reservoirs, Wellbore/ Tubing performance of oil and gas wells; single phase and multi-phase well flow models, homogeneous and separated flow models, mechanistic and empirical models, pressure traverse and pressure drop estimation, Estimating the choke performance; single phase, multiphase, critical and sub critical flow models, Deliverability of oil and gas wells; principle of system analysis (NODAL^{TM} Analysis) with simplified well configuration, use of IPR and TPR (Tubing Performance Relationship), forecast of Well production; forecasting the behavior of and oil or gas well using the principle of Nodal analysis and material balance.

RECOMMENDED BOOKS:

1. Petroleum Production Systems: A computer Assisted Approach by Boyun Gue, William C. Lyons and Ali Ghalambor Elsevier Science & Technology Books, ISBN: 0750682701.
2. Petroleum Production Systems, 2nd Edition, Michael J. Economides, A. Daniel Hill, Christine Ehlig-Economides, Ding Zhu, Prentice Hall ISBN: 013658683X
3. Production Optimization using NODALTM Analysis, by H. Dale Beggs, OGCI, ISBN: 978-0930972141.

Pet.E-318 PROPERTIES OF RESERVOIR FLUIDS

Basic concept of phase behavior; single, binary, and multi-component systems. The five reservoir fluids, properties of gases. Properties of dry gases, wet gases, Gas condensates.

Properties of Black oils, Determination of reservoir fluid properties by

1. Field data

2. Laboratory Analysis
3. Correlation's
4. Equations of state

Properties of oil field waters and Hydrates.

Use of existing/available software for phase behavior calculations.

LAB OUTLINES:

1. Determination of different oil properties including
2. Flash Point of Crude Oil.
3. Cloud & Pour Point of Crude Oil.
4. Density/ Specific Gravity of Crude Oil.
5. Kinematic Viscosity of Crude Oil.
6. Sulfur percentage in Crude Oil.

RECOMMENDED BOOKS:

1. Properties of Petroleum Fluids by William D. McCain Jr. 3rd Edition, PennWell Books, 2017, ISBN: 978-159370373-8.
2. Phase Behavior of Petroleum Reservoir Fluids, Karen Schou Pedersen, Peter L. Christensen, Jawad Azeem Shaikh, 2nd Edition, CRC Press, 2014, **ISBN**: 978-1439852231

Pet.E-319 WELL TEST AND ANALYSIS

Analytical solution of the diffusivity equation for constant rate and constant pressure under transient and pseudo-steady state flow regimes; skin effect due to well-bore damage and storage; Analytical / numerical solution of diffusivity equation including damage and storage presented in the graphical form and its use as a diagnostic plot; Principle of superposition and Horner's approximation of pseudo-time.

Pseudo build-up analysis; Ideal build-up test and actual build-up test; Determination of reservoir permeability, skin factor, flow efficiency etc.; Pseudo-skin; Analysis of hydraulically fractured wells; Determination of static drainage area by P* and Muscat method; Distance to fault and areal extent determination; Transient equation for gases including well-bore damage, storage, and turbulence factor.

Drawdown analysis oil and gas well; Multi rate testing; Deliverability Testing for gas wells; multi-well testing; Use of type curves and derivative curves; Discussion of Ramey's, Gringarten's and Mckinley's type curves.

LAB OUTLINES:

1. Class Project.
2. Class assignment on each chapter of the book taught.
3. Quizzes/ viva voces. / Surprise tests etc.
4. Presentations.
5. Software Application.

RECOMMENDED BOOKS:

1. John Lee., Well Testing, SPE Textbook Series, ISBN: 978-0895203175.
2. Lee, Rollins & Spivey., Pressure Transient Testing, SPE, ISBN: 978-1555630997
3. M A Sabet., Well Test Analysis, Gulf Publishing Company, ISBN: 978-0872015845
4. George Stewart., Well Test Design & Analysis, PennWell Corporation, ISBN: 978-1593702311.

Pet.E-321 NATURAL GAS PROCESSING AND TRANSPORTATION

Introduction to natural gas industry; Natural gas properties; Flow and compression calculations; Natural gas processing: phase separation, dehydration, sweetening and fractionation of natural gas including design of dehydration units; Gas flow measurements; Natural gas transmission; Distribution of natural gas in the city; Gas stations; Design of natural gas pipelines; Natural gas pipeline construction; Gas storage; Maintenance of natural gas pipelines: pigging and corrosion prevention/ control.

LAB OUTLINES

Coverage/ completion of lab manuals/ tutorials focusing on:

1. Application of ideal and real gas laws and determination of z-factor in different cases and by different methods
   a. Using given composition and Standing & Katz chart
   b. Using gas gravity and Standing & Katz chart
   c. Using empirical correlations
2. Determination of viscosity of natural gas samples using analytical/ empirical correlations
   a. Carr et al. Correlation
   b. Lee et al. Correlation

3. Determination of water content in sweet and sour natural gas streams
   a. McKetta & Wehe Correlation
   b. Wichert & Wichert Correlation
4. Estimation/ prediction of gas hydrates formation in natural gas pipeline/ compression systems using correlations
5. Use of modern tools/ software for solution of pipeline flow and flow assurance problems
   a. Design of surface network(s)
   b. Prediction/ prevention of wax/ hydrates formation.

RECOMMENDED BOOKS:

1. Donald L. Katz et al., Handbook of Natural Gas Engineering, ISBN: 9780070333840.
2. Saeid Mokhatab & William A. Poe, Handbook of Natural Gas Transmission & Processing, ISBN: 9780080466972
3. A. W. Peabody, Peabody's Control of Pipeline Corrosion, ISBN: 9781575903361
4. E. Shashi Menon, Pipeline Planning & Construction – Field Manual, ISBN: 9780123838674
5. Xiuli Wang & Michael Economides, Advanced Natural Gas Engineering, ISBN: 9781933762388.

Pet.E-323 FIELD OPERATIONS IN PETROLEUM ENGINEERING

Drilling Operations: Executing Fishing, Cementing and Coring operations.

Well Completion: Performing perforation job; Liner placement; Executing Sand control procedures; Conducting Well Testing operations.

Production Operations: Procedures related to Scale Removal, Nitrogen Shooting, Coiled Tubing operations, Acidizing, Hydraulic Fracturing, Snubbing

RECOMMENDED BOOKS:

1. Advanced Well Control, David Watson, Terry Brittenham, ISBN: 978-1555631017.
2. Petroleum Well Construction, Michael J. Economides, Larry T. Watters, ISBN: 978-0471969389.
3. Applied Drilling Engineering, A. T. Bourgoye Jr., K. K. Millheim, ASIN: B01L0PRBX2.
4. Petroleum Production Systems, Michael J. Economides, A. Daniel Hill Christine Ehlig-Economides, ISBN: 978-0137031580, 2nd Edition.
5. Production Operations (Volume 1, 4th Edition), Thomas O. Allen, Alan P.Roberts, ISBN: 978-0930972196.
6. Natural Gas Production Engineering, Chi U. Ikoku, ISBN: 978-0471894834.

Pet. E-351 MINI PROJECT-III

Project will be offered with reference to Petroleum & Gas Engineering, sustainable development, and future energy related to Sustainable Development Goals (SDGs). This project is offered to non-Muslim students in lieu of Translation of Holy Quran-III.

Pet.E-411 DRILLING ENGINEERING-II

Directional drilling and deviation control, Definitions, and reasons for directional drilling, planning the directional well trajectory, planning the kick-off and trajectory change, Deflection tools. Factors affecting rate of penetration (ROP), overview of horizontal drilling.

Drill stem testing (DST), test procedure and common considerations, Test tool components and their arrangement, Analysis of test data, formation damage causes and prevention of formation damage.

Oil well cementing. Primary oil well cementing techniques, types of cement, cement additives and factors considered for the preparation of cement recipe, cement volumes calculation, Squeeze cementing and Stage cementing techniques.

Drilling economics, Equipment cost, slim hole drilling, Managed Pressure Drilling (MPD), HTHP Drilling Challenges, Drilling Optimization Considering Different Cost Factors, and Fishing Operations. Offshore Drilling Operations, offshore rig selection criteria, offshore well construction.

LAB OUTLINES:

1. Studio work of Casing Design
2. Presentations
3. Quiz

RECOMMENDED BOOKS:

1. Applied Drilling Engineering by Adam. T. Bourgoyne Jr., Keith. K. Millheim, SPE Textbook Series, Vol 2, ISBN-13: 978-1555630010, ISBN-10: 1555630014, Publisher: Society of Petroleum Engineers
2. Well Engineering and Construction by Hussain Rabia, ISBN-10: 0954108701, ISBN-13: 978-0954108700, Publisher: Entrac Consulting
3. Horizontal Well Technology, by S.D. Joshi, ISBN-13: 978-0878143504, ISBN-10: 0878143505, Publisher: PennWell Corp. First Edition
4. Well Cementing by Erik B. Nelson, ISBN-10: 0444555803, ISBN-13: 978-0444555809, Publisher: Elsevier Scienc

5. Petroleum Well Construction by Michael J. Economides, Larry T. Watters, Shari Dunn-Norman, ISBN-10: 0471969389, ISBN-13: 978-0471969389, Publisher: Wiley; 1st edition
6. Offshore Petroleum Drilling and Production by Sukumar Laik, ISBN-10: 9781498706124, ISBN-13: 978-1498706124, ASIN: 1498706126, Publisher: CRC Press; 1st edition.

Pet.E-422 PRINCIPLES OF RESERVOIR SIMULATION

Introduction: Overview and role of reservoir simulation in petroleum, its advantages, and limitations, basic steps of a reservoir simulation study.

Formulation: Developing a model for single phase, incompressible, slightly compressible, and compressible fluids at different reservoir conditions, formulation of partial differential equations governing single phase and multiphase flow in porous media.

Reservoir modeling: Types of models, required data, model initialization, gridding system, space, and time discretization.

Numerical solution: Numerical methods to solve partial differential equations, implicit and explicit solution methods, stability, convergence, and accuracy considerations.

Applications: Reservoir modeling, history matching, and performance prediction.

LAB OUTLINES

Introduction to different petroleum reservoir simulators, input data requirements and selection criteria for different simulation models based on reservoir conditions.

Use of Black oil and Compositional Simulators. Input data keywords and data file preparation. Evaluation of different numerical solutions such as implicit and explicit methods. Fine tuning for history matching and Performance prediction.

RECOMMENDED BOOKS:

1. Turgay Ertekin, Jamal H. Abou-Kassem, Gregory R. King, Basic Applied Reservoir Simulation, SPE Textbook Series Vol. 7, Richardson Texas. **ISBN:** 978-155563089-8
2. Donald W. Peaceman, Fundamentals of Numerical Reservoir Simulation, Elsevier Science, **ISBN:** 978-044455298-3.
3. Calvin C. Mattax, Robert L. Dalton, Reservoir Simulation, SPE Monograph Series Vol. 13, **ISBN:** 978-155563028-7.

4. M. R. Islam, S. M. Farouq Ali, Jamal H. Abou-kassem, Petroleum Reservoir Simulation: A basic Approach, Gulf Publishing company, **ISBN:** 978-097651136-6.
5. Mike Carlson, Practical Reservoir Simulation, ISBN: 978-0878148035.
6. Reservoir Simulation: History Matching and Forecasting by James R. Gilman; Chet Ozgen Society of Petroleum Engineers, DOI: https://doi.org/10.2118/9781613992920, ISBN electronic: 978-1-61399-881-6, Publication date: 2013.

Pet.E-425 PETROLEUM PRODUCTION ENGINEERING-II

Causes of low well productivity: Reservoir dominated factors, well bore dominated factors, mechanical failures.

Well Performance Prediction: Decline curve analysis, Material balance method, and reservoir simulation.
Well services and work over jobs: Squeeze jobs, re-perforation, well cleaning.
Stimulation Techniques:
Hydraulic Fracturing: Introduction, inducing, productivity ratio, fracture area, fracturing fluid coefficients, fractures efficiency, fracturing hydraulics, fracture design and calculation.
Acidizing: Introduction, types of treatment, acid-fracturing design, Sandstone acidizing design, Carbonate acidizing design, Productivity Improvement from Acidization, Acid Systems, Acid Additives.
Artificial Lift Methods: Introduction and selection criteria, the need for artificial lift, selection of artificial lift criteria. Rod pumps, Gas lift, Electric submersible pumps, Hydraulic pumps (application, operational procedure, advantages, and limitations).

LAB OUTLINES:

1. Establishing different Inflow Performance Relationships.
2. Determination of vertical lift performance of a well using choke and bottom-hole parameters.
3. Determination of reservoir/bottom-hole parameters using surface production data.
4. Interpretation of Production Logging Tool data for well diagnostics.
5. Determination of productivity ratio of a reservoir stimulation job.
6. Well hydraulics calculations for an anticipated stimulation job.
7. Complete hydraulic fracture design and its modeling.
8. Complete acid fracturing job and its modeling.
9. Graphically determining the point of gas injection for a gas lift design.
10. Universal valve spacing design for a gas lift installation.

RECOMMENDED BOOKS:

1. Petroleum Production Systems: A computer Assisted Approach by Boyun Gue, William C. Lyons and Ali Ghalambor ISBN: 0750682701.
2. Introduction to Petroleum Production; Volume I & II by D. R. Skinner, ISBN: 0872017672.
3. Surface Operation in Petroleum Production, by G. V. Chillingarian, J. O. Robertson, ISBN: 0444424733.
4. Production Operations, by Thomas O. Allen and Alan P. Roberts, ISBN: 978-0930972196.
5. Petroleum Production Systems by Michael J. Economides, A. Daniel Hill, ISBN: 013658683X.

Pet.E-427 RESERVOIR MANAGEMENT

Introduction and objectives of reservoir management and its importance in maximizing hydrocarbon recovery. Material balance equation and its different forms with their application in petroleum reservoirs. The Key Concepts of Relative Permeability and Capillary Pressure with respect to reservoir fluid dynamics. Reservoir performance prediction using different techniques and required data. Reservoir simulation integration in reservoir management. Overview of production optimization techniques and integrated asset management (IAM). Reservoir management challenges and solutions

LAB OUTLINES

1. Exercises and Class Projects on:
   i. MBE and its different forms
   ii. Performance prediction with different techniques
   iii. Field development planning
2. Software Applications and Presentations.

RECOMMENDED BOOKS:

1. Oil reservoir Engineering by S.J. Pirson, ISBN-13:978-0070500747, 2nd Rev Edition
2. Advanced Reservoir Engineering by Tarek Ahmed, ISBN 9780750677332.
3. Applied Petroleum Reservoir Engineering, B.C. Craft & M.F. Hawkins, ISBN: 978-0133155587.
4. Reservoir Management: Principles and Practice" by Steve H. Henderson
5. Reservoir Engineering Handbook" by Tarek Ahmed
6. Reservoir Management for Waterfloods" by R.C. Selley, Stephen A. Sonnenberg
7. Integrated Reservoir Asset Management" by John R. Fanchi.

Pet.E-429 PRINCIPLES OF ENHANCED OIL RECOVERY

Factors Common to all Enhanced Recovery Methods: Scope of Enhanced Oil Recovery (EOR); EOR screening criteria; Effect of petrophysical and fluid properties: Wettability, Saturation, Relative permeability, Interfacial tension, Viscosity; Linear displacement; Two- and three-dimensional displacement. Injection well location; Areal sweep efficiency for pattern floods.

Water Injection: Displacement mechanics and performance calculations; Practical considerations in water injection projects Frontal Advance and Buckley and Leveret theory.

Immiscible Displacement by Gas Injection: Preliminary studies and field evaluation of injection efficiency; Injection and production well completions; Surface installations, compression, and treatment methods; Special applications of gas injection.

Miscible Drive: Miscible slug flooding; Thermodynamic miscibility; Ternary diagram; Basic and improved methods of miscible drive; Carbon dioxide flooding.

Gas Recycling in Gas-Condensate Reservoirs: Thermodynamics of gas recycling; Sweep efficiency; Well locations; Production control; Production equipment and determination of operating conditions.

Thermal Recovery Methods: Data requirements; Hot fluid displacement; In-situ combustion.

Chemical EOR Processes: Use of polymers; Foam injection; Use of surfactant solutions and micro-emulsions.

Calculations: Example calculations and solution of problems involving various EOR scenarios.

LAB OUTLINES:

Coverage/ completion of lab manuals/ tutorials focusing on following topics and involving the usage of modern tools:

1. Screening criteria for EOR studies/ projects
2. Mobility Ratio: Governing factors and effects/ implications of its variation
3. Fractional flow theory and related calculations
4. Pre-breakthrough, breakthrough and post-breakthrough scenarios at production wells during waterflooding
5. Applications of ternary diagrams in miscible processes
6. Design calculations for thermal EOR methods.
7. Design calculations for chemical EOR methods.

RECOMMENDED BOOKS:

1. Deryck Bond and Samuel Krevor., The Imperial College Lectures in Petroleum Engineering: Topics in Reservoir Management, Volume 3, ISBN: 978-1786342843, World Scientific

2. Laura Romero-Zeron (Editor), Chemical Enhanced Oil Recovery (cEOR) - a Practical Overview, ISBN: 978-9535127000, InTechOpen.
3. Sheng, J. J., Enhanced Oil Recovery Field Case Studies, ISBN: 978-0123865458, Gulf Professional Publishing, Elsevier.

of EOR by teaching the motives of the EOR including key constraints of the successful EOR operations.

Pet.E-451 MINI PROJECT-IV

Project will be offered with reference to Petroleum & Gas Engineering, sustainable development, and future energy related to Sustainable Development Goals (SDGs). This project is offered to non-Muslim students in lieu of Translation of Holy Quran-IV.

Pet.E-461 INTERNSHIP

Internship requirement for six to eight weeks preferably during summer vacation or semester break (mandatory and qualifying). The student may choose their internship in the following areas.

1. Industry
2. Community Service
3. Any assignment at UET (in case internship is not arranged in Industry and Community Service).

Pet.E-498 FINAL YEAR DESIGN PROJECT (Phase-I)

Final year Design project (FYDP) is an essential part of undergraduate curricula and is considered as a capstone in curricula structure. It provides the students with a unique close to real-life experience related to Engineering problems. He/she applied his/her knowledge to create some innovative elements. While going through, the students are expected to utilize their previous knowledge of science and engineering, sharpen their skills and concepts, and achieve the highest possible level of learning through design and or review or investigation kind of projects. Students are exposed to real constraints of finance, time, resources, and they have to come up with methodology to fulfill the objectives within the constraints. Each student needs to demonstrate sound problem solving and analytical skills both in a group and individually. It will be evaluated at the end of 8th Semester.

Pet.E-499 FINAL YEAR DESIGN PROJECT (Phase-II)

Every student must submit a comprehensive report on an assigned Final Year Design Project at the end of his/her eighth semester for the partial fulfillment of his degree. He/she shall work on assigned topic from 7th semester and show his competency towards his knowledge/education learned throughout his/her degree tenure. He/she has to undergo the human constraints, unforeseen circumstances, and took in account the United

Nations's Sustainability Development Goals in order to achieve his/ her degree completion target. This will be evaluated at end of 8th semester through but not limited to presentation and/ or final viva-voce.

Note:

Freshly admitted students, especially foreign students, may have to take additional subjects as pre-requisites, over and above the credits required towards completion of the degree. These subjects will not be counted towards completion of their degree requirement.