Curriculum

for

Bachelor of Petroleum & Gas Engineering Technology

Degree

(2023)

Higher Education Commission
Islamabad
Curriculum Division

Acronyms, Abbreviations & Definitions

Acronym/Abbreviation	Definition
NTC	National Technology Council
NCRC	National Curriculum Review Committee
HEI	Higher Education Institution
SMEs	Small and Medium Enterprises
SIT	Supervised Industrial Training
IDTE	Inter Disciplinary Technology Elective
SPE	Society of Petroleum Engineers
IEEE	Institute of Electrical and Electronics Engineers
PVT	Pressure, Volume, Temperature
LPG	Liquid Petroleum Gas
EIA	Environmental Impact Assessment
GPS	Global Positioning System
ASTM	American Society of Testing and Materials
API	American Petroleum Institute
SCAL	Special Core Analysis
CBM	Coal Bed Methane
HPHT	High-Pressure High Temperature
Th	Theory
Lab	Laboratory
Cr. Hrs.	Credit Hours

Contents

1. Introduction

Curriculum is the total learning experience of a student that occurs in the educational process. The term refers specifically to a planned sequence of instruction, and to the student's experiences in terms of the educator's or institutions instructional goals. Curriculum is a systematic and intended packaging of competencies (i.e., knowledge, skills, and attitudes, underpinned by values) that learners should acquire through organized learning experiences.

Curriculum forges in learners' life-long learning competencies, as well as social attitudes and skills, such as tolerance and respect, constructive handling of diversity, peaceful conflict management, promotion and respect of Human Rights, gender equality, justice, and inclusiveness. At the same time, curriculum must be singularly aligned to national development goals, and produce human resources that becomes an effective factor of production in the economy.

Curriculum is thus the foundation on which rests the edifice of academic programs designed for focused outcomes that equip graduates with desired skill sets. Engineering technology curriculum aims to produce proficient engineering technology graduates who meet demands of both national and international job markets. The curriculum conforms substantially to the Sydney Accord – the international accreditation body regulating local accrediting institutions of partnering countries -- and is in consonance with the essence of Graduates Attributes and Professional Competence defined by International Engineering Alliance (IEA). [See Appendixes A through C]

Curriculum is developed and reviewed by HEC's National Curriculum and Review Committee (NCRC).

2. Curriculum Development Methodology

2.1 Benchmarking

Curriculum for Petroleum & Gas Engineering Technology is benchmarked to HEC's Undergraduate Policy and in accordance with NTC Curriculum Framework. It conforms substantially to the standards laid out by the Sydney Accord and the International Engineering Alliance pertaining to engineering technology programs [See Appendixes A through C].

The course of studies clearly defines and differentiates the program from Petroleum & Gas Engineering by contact hours spent in classrooms, laboratories, and industry.

Ideally an engineering program is designed with classroom to practical training ratio of 70:30 contact hours with emphasis on design aspects. Whereas for engineering technology programs, the ratio of contact hours is reversed to 30:70, providing more opportunity for hands on and psychomotor training.

2.2 Curriculum Development Cycle

Curriculum development is a rigorous process and entails the following steps:

- Nominations are requested from academic circles and relevant industry forums to constitute a National Curriculum Review Committee (NCRC) comprising of leading national experts.
- From the nominations received, NCRC is finalized and notified by NTC/HEC.
- A Preliminary Meeting of the NCRC, spanning three days, is held to establish framework and benchmarking issues, and assign different facets of curriculum development to smaller teams within the NCRC.
- NCRC Members elect a Convenor, a co-Convenor, and a Secretary amongst themselves for the proceedings of NCRC, after mutual consultations.
- A draft of the curriculum is prepared by NCRC at the end of the Preliminary Meeting and sent to relevant foreign experts for review and feedback.
- After the foreign expert's review and feedback, a Final NCRC Meeting, lasting up to three days, is held to finalize the NCRC Members recommendations, and prepare a final curriculum document.
- The entire cycle of curriculum development is completed in two months.

2.3 Historical Timeline of Meetings

Historical Timeline of NCRC meetings to develop Bachelor of Petroleum & Gas Engineering Technology are enlisted below:

- Preliminary Meeting of NCRC [See Appendix D]
- Final Meeting of NCRC [See Appendix E]

3. Curriculum Details

Bachelor of Petroleum & Gas Engineering Technology Program			
Parameter	**HEC Framework**	**Framework - A (SIT in 7th & 8th Semesters)**	**Framework - B (SIT in 8th Semester Only)**
Program Type	Semester System	Semester System	Semester System
Program Duration	8 Semesters Min: 4 Years Max: 7 Years	8 Semesters Min: 4 Years Max: 7 Years	8 Semesters Min: 4 Years Max: 7 Years
Semester Duration	16 weeks of Teaching 2 weeks for Exams	16 weeks of Teaching 2 weeks for Exams	16 weeks of Teaching 2 weeks for Exams
Total Number of Courses	41	39	44**
Engineering Technology Domain Courses	28	26	31**
Non-Engineering Technology Domain Courses	13	13	13
Total Credit Hours	124 – 136	136	136
Engineering Technology Domain Credit Hours	85	101	101
Percentage of Engineering Technology Domain Courses	74.42%	66.34%	70.83%
Non-Engineering Technology Domain Credit Hours	39	35	35
Percentage of Non-Engineering Technology Domain Courses	31.45%	33.65%	29.16%
No. of Credit Hours per Semester	15 – 18	16 – 18	16 – 18
** Optional Courses in 7th Semester shall be included for Framework B (SIT in 8th Semester only)			
1 credit hour: (1) For theory: 1 contact hour per week for a minimum of 16 weeks for theory. (2) For practical's: 3 contact hours per week for a minimum of 16 weeks for practical's.			

Engineering Technology Domain Courses in Recommended Schemes of Studies as per Framework							
Knowledge Area	**Name of Course**	**Credit Hours** (Th+Lab)	**Weekly Contact Hours** (Th+Lab)	**Total Credit Hours**		**Number of Courses**	
				As per Scheme of Studies	**As per NTC Framework**	**As per Scheme of Studies**	**As per NTC Framework**
Computing	Computer Fundamentals	1+1=2	1+3=4	7	6	3	3
	Computer Programing & Software Application	1+1=2	1+3=4				
	Application of Reservoir Simulation	2+1=3	2+3=5				
Petroleum & Gas Engineering Technology (Foundation)	Technical Drawing & Graphics	1+1=2	1+3=4	22	20	9	10
	Geophysical Surveying	1+1=2	1+3 =4				
	Workshop Technology	0+2=2	0+6 =6				
	Applied Thermodynamics	2+1=3	2+3=5				
	Environment & Safety Management	2+0=2	2+0=2				
	Fluid Mechanics	2+1=3	2+3=5				
	Petroleum Geology	2+1=3	2+3=5				
	Mechanics of Material	2+0=2	2+0=2				
	Fundamentals of Heat and Mass Transfer	2+1=3	2+3 =5				
Petroleum & Gas Engineering Technology (Breadth)	Formation Evaluation	2+1=3	2+3=5	12	24	4	6
	Reservoir Fluids	2+1=3	2+3=5				
	Breadth Elective-I	2+1=3	2+3=5				
	Breadth Elective-II	2+1=3	2+3 =5				
Petroleum & Gas Engineering Technology (Depth)	Drilling Engineering Technology	2+1=3	2+3=5	18 / 34**	14	6 / 11**	5
	Reservoir Engineering Technology	2+1=3	2+3=5				
	Petroleum Production Technology	2+1=3	2+3=5				
	Depth Elective-I	2+1=3	2+3=5				
	Depth Elective-II	2+1=3	2+3=5				
	Depth Elective-III**	2+1=3	2+3=5				
	Depth Elective-IV**	2+1=3	2+3=5				
	Depth Elective-V**	2+1=3	2+3=5				

	Depth Elective-VI**	2+1=3	2+3=5				
	Depth Elective-VII**	2+1=3	2+3=5				
	Depth Elective-VIII**	2+2=4	2+6=8				
IDTE	IDTE-I	1+1=2	1+3=4	4	5	2	2
	IDTE-II	1+1=2	1+3=4				
Senior Design Project	Project Part-I	0+3=3	0+9=9	6	6	2	2
	Project Part-II	0+3=3	0+9=9				
Training	Supervised Industrial Training-(Opt.)	0+16=16	0+16=16	16**		0	
	Supervised Industrial Training	0+16=16	0+16=16	16		0	
Total Credit Hours and Courses (For Engineering Technology Domain Courses)		50+67 = 117	50+139 = 189	98 - 110		27 - 31	

** Optional Courses in 7th Semester shall be included for Framework B (SIT in 8th Semester only)

Non-Engineering Technology Domain Courses in Recommended Schemes of Studies as per Framework								
Knowledge Area	**Sub Area**	**Name of Course**	**Credit Hours** (Th+Lab)	**Weekly Contact Hours** (Th+Lab)	**Total Credit Hours**		**Number of Courses**	
					As per Scheme of Studies	**As per NTC Framework**	**As per Scheme of Studies**	**As per NTC Framework**
Humanities and Social Sciences	English (Expository Writing)	Communication Skills	3+0=3	3+0=3	6	6	2	2
		Technical Report Writing	3+0=3	3+0=3				
	Culture	Islamic Studies / Ethics	3+0=3	3+0=3	6	6	2	2
		Pakistan Studies	3+0=3	3+0=3				
	Social Sciences Electives	Elective-I (Professional Ethics)	3+0=3	3+0=3	3	9	1	3
		Elective-II (Optional)	2+0=2	2+0=2				
Management Sciences	Management Sciences	Elective-III (Optional)			8	6	3	3
		Elective-I	3+0=3	3+0=3				
		Elective-II	3+0=3	3+0=3				
Natural Sciences	Math (Quantitative Reasoning)	Calculus and Analytical Geometry	2+0=2	2+0=2	6	6	3	2
		Differential Equations	2+0=2	2+0=2				
		Linear Algebra	2+0=2	2+0=2				
	Applied Chemistry	Applied Chemistry	2+1=3	2+3=5	3	4	1	1
	Elective	Elective-I	2+1=3	2+3=5	3	4	1	1
Total Credit Hours and Courses ** Optional Courses in 7th Semester shall be included for Framework B (SIT in 8th Semester only)					Cr. Hrs. **35**		Courses **13**	

<table>
<tr><th colspan="2">List of Elective Topics</th></tr>
<tr><th>Social Sciences</th><th>Management Sciences</th></tr>
<tr><td>➢ Professional Ethics
➢ Sociology for Technologist
➢ Critical Thinking
➢ Organizational Behavior
➢ Professional Psychology
➢ Elective Courses by HEI*</td><td>➢ Economics for Technologist
➢ Project Management
➢ Entrepreneurship
➢ Leadership and Personal Grooming
➢ Elective Courses by HEI*</td></tr>
<tr><th>Natural Sciences*</th><th rowspan="3">Depth Electives*</th></tr>
<tr><td>➢ Multivariable Calculus
➢ Discrete Mathematics
➢ Numerical Analysis
➢ Applied Physics
➢ Elective Courses by HEI*</td></tr>
<tr><th>Breadth Electives*</th></tr>
<tr><td>➢ Petroleum Refinery Technology
➢ Reservoir Geomechanics
➢ Unconventional Resources
➢ Corrosion Control Technologies
➢ Sustainable oil & gas Technology
➢ Offshore Technology
➢ Well Stimulation Techniques
➢ Artificial Lift Technology
➢ Non-Destructive Testing
➢ Elective Courses by HEI*</td><td>➢ Surface Petroleum Operations
➢ Oil Field Chemistry
➢ Well Control Techniques
➢ Drilling Fluid hydraulics
➢ Petrochemical Waste Management
➢ Petroleum Resources & Reserves Estimation
➢ Well Testing
➢ Principles of Enhanced Oil Recovery
➢ Gas Processing Technology
➢ Flow Assurance
➢ Flow In Porous Media
➢ Gas Reservoir Engineering
➢ Instrumentation and Process Control
➢ Elective Courses by HEI*</td></tr>
<tr><td colspan="2">*Any related course can be included with approval of the HEI's Statutory Bodies (maximum: 3 courses per elective knowledge area)</td></tr>
</table>

4. Admission Criteria

Criteria for admission in Bachelor of Petroleum & Gas Engineering Technology program is defined in NTC's Program Accreditation Policy and Procedures Manual for Engineering & Other Technologies, Clause 3.2.4.1. The salient features for eligibility for admission are:

(1) At least 50% marks in DAE/FSc (Pre-engineering)
or other equivalent qualifications such as A-level/ICS/B.Sc. (sports and Hafiz-e-Quran marks are not included) and

(2) Entrance Test

(3) Weightage:

- 70% for academics (DAE/FSc etc.)
- 30% for Entrance Test

5. Semester-wise Scheme of Studies

Semester-wise scheme of studies for the Bachelor of Petroleum & Gas Engineering Technology program, spanning 4 years, spread over 8 semesters, and totaling 136 credit hours is presented below, along with weekly contact hours for each course.

SEMESTER-I				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	
PGH-111/ PGH-112	Islamic Studies / Social Ethics	Art & Humanities-I	3+0	3+0
PGE-111	Communication Skills	Expository Writing-I	3+0	3+0
PGQ-111	Calculus & Analytical Geometry	Quantitative Reasoning-I	2+0	2+0
PGN-112	Applied Physics	Natural Sciences-I	2+1	2+3
PGC-111	Computer Fundamentals	Computing-I	1+1	1+3
PGT-111	Workshop Technology	Petroleum & Gas Engineering Technology Foundation-I	0+2	0+6
PGT-112	Mechanics of Material	Petroleum & Gas Engineering Technology Foundation-II	2+0	2+0
Subtotal			**13+4 =17**	**13+12 =25**
SEMESTER-II				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	
PGH-121	Pakistan Studies	Art & Humanities -II	3+0	3+0
PGQ-121	Differential Equations	Quantitative Reasoning-II	2+0	2+0
PGT-121	Applied Thermodynamics	Petroleum & Gas Engineering Technology Foundation-III	2+1	2+3
PGT-122	Technical Drawing & Graphics	Petroleum & Gas Engineering Technology Foundation-IV	1+1	1+3
PGC-121	Computer Programing & Software Application	Computing-II	1+1	1+3
PGT-123	Fluid Mechanics	Petroleum & Gas Engineering Technology Foundation-V	2+1	2+3
PGT-124	Petroleum Geology	Petroleum & Gas Engineering Technology Foundation-VI	2+1	2+3
Subtotal			**13+5 =18**	**13+15 =28**

SEMESTER-III				Weekly Contact Hrs. (Th+Lab)
Suggested Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
PGE-211	Technical Report Writing	Expository Writing-II	3+0	3+0
PGQ-211	Linear Algebra	Quantitative Reasoning-II	2+0	2+0
PGT-211	Fundamentals of Heat and Mass Transfer	Petroleum & Gas Engineering Technology Foundation-VII	2+1	2+3
PGT-212	Geophysical Surveying	Petroleum & Gas Engineering Technology Foundation-VIII	1+1	1+3
PGN-211	Natural Science Elective-I	Natural Sciences-II	2+1	2+3
PGI-211	IDTE-I	Inter Disciplinary Technology Elective-I	1+1	1+3
PGT-213	Reservoir Fluids	Petroleum & Gas Engineering Technology Breadth Core-II	2+1	2+3
Subtotal			**13+5 =18**	**13+15 =28**

SEMESTER-IV				Weekly Contact Hrs. (Th+Lab)
Suggested Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
PGT-221	Environment & Safety Management	Petroleum & Gas Engineering Technology Foundation-IX	2+0	2+0
PGT-222	Reservoir Geomechanics	Petroleum & Gas Engineering Technology Breadth Elective-I	2+1	2+3
PGT-223	Formation Evaluation	Petroleum & Gas Engineering Technology Breadth Core-I	2+1	2+3
PGH-221	Professional Ethics	Social Science-I	3+0	3+0
PGT-224	Drilling Engineering Technology	Petroleum & Gas Engineering Technology Depth Core-I	2+1	2+3
PGI-221	IDTE-II	Inter Disciplinary Technology Elective-II	1+1	1+3
PGH-221 / PGM-221	Leadership and Personal Grooming	Social Science-II / Management Sciences-III	2+0	2+0
Subtotal			**14+4 =18**	**14+12 =26**

SEMESTER-V				Weekly Contact Hrs. (Th+Lab)
Suggested Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
PGM-311	Economics for Technologist	Management Sciences-I	3+0	3+0
PGT-311	Reservoir Engineering Technology	Petroleum & Gas Engineering Technology Depth Core-II	2+1	2+3
PGT-312	Corrosion Control Technologies	Petroleum & Gas Engineering Technology Breadth Elective-II	2+1	2+3

PGM-312	Entrepreneurship	Management Sciences-II	3+0	3+0
PGT-313	Well Testing	Petroleum & Gas Engineering Technology Depth Elective-I	2+1	2+3
PGT-314	Project Part-I	Petroleum & Gas Engineering Technology Domain Project	0+3	0+9
Subtotal			**12+06 =18**	**12+18 =30**
SEMESTER-VI				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	
PGT-321	Petroleum Production Technology	Petroleum & Gas Engineering Technology Depth Core-III	2+1	2+3
PGC-321	Application of Reservoir Simulation	Computing-III	2+1	2+3
PGT-322	Gas Processing Technology	Petroleum & Gas Engineering Technology Depth Elective-II	2+1	2+3
PGT-323	Instrumentation and Process Control	Petroleum & Gas Engineering Technology Depth Elective-III	2+1	2+3
PGT-324	Project Part-II	Petroleum & Gas Engineering Technology Domain Project	0+3	0+9
Subtotal			**8+07 =15**	**8+21 =29**
SEMESTER-VII				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs.** (Th+Lab)	
ELT-411	Supervised Industrial Training (Optional)	Petroleum & Gas Engineering Technology Domain Industrial Training	16	40 (Per Week)
PGT-411	Oil Field Chemistry	Petroleum & Gas Engineering Technology Depth Elective-IV	2+1	2+3
PGT-412	Principles of Enhanced Oil Recovery	Petroleum & Gas Engineering Technology Depth Elective-V	2+1	2+3
PGT-413	Petrochemical Waste Management	Petroleum & Gas Engineering Technology Depth Elective-VI	2+1	2+3
PGT-414	Well Control Techniques	Petroleum & Gas Engineering Technology Depth Elective-VII	2+1	2+3
PGT-415	Surface Petroleum Operations	Petroleum & Gas Engineering Technology Depth Elective-VIII	2+2	2+6
Subtotal			**10+6=16**	**10+18 =28**

SEMESTER-VIII				**Weekly Contact Hrs. (Th+Lab)**
Suggested Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs.** (Th+Lab)	
PGT-421	**Supervised Industrial Training (Compulsory)**	Petroleum & Gas Engineering Technology Domain Industrial Training	**16**	**40 (Per Week)**
Subtotal			**0+16= 16**	**0+40= 40**
Total Credit Hours & Contact Hours in Four Years (When SIT conducted in both 7th and 8th Semester)			**73+63 = 136**	**73+127=200**
Theory vs Practical with respect to Contact Hours			Theory Practical	73 (36.5%) 127 (63.5%)
Total Credit Hours & Contact Hours in Four Years (When optional courses conducted instead of SIT in 7th Semester**)**			**83+53 = 136**	**83+129 =212**
Theory vs Practical with respect to Contact Hours			Theory Practical	83 (39.15%) 129 (60.84%)

6. Course Codes

Details pertinent to course code are presented below:

- Each course has a unique three letter prefix, followed by three-digit code
- Letters are acronyms for course description, and numbers define the chronological position in the academic year and sequence number in the program.
- The program will span over 4 years, with 2 semesters per year, Spring and Fall (with possible inclusion of Summer Semester).

Letters in course-code prefix are defined below:

- First two letters pertain to the program (e.g., PG for Petroleum & Gas)
- The third letter pertains to specifics of the course (e.g., T for technology, E for expository writing etc.)

Digits in course-code are defined in table below:

1st Digit	2nd Digit	3rd Digit
Denotes Year (1,2,3,4)	Denotes Semester (1,2,3…)	Denotes Sequence (1, 2, 3…)

Course Code Examples		
Sr.	**Course Code Prefix**	**Description**
1	PG**T**	Petroleum & Gas Engineering Technology Foundation/ Breadth/ Depth
2	PG**E**	Expository Writing
3	PG**H**	Art & Humanities
4	PG**S**	Social Sciences
5	PG**Q**	Quantitative Reasoning
6	PG**N**	Natural Sciences
7	PG**C**	Computing
8	PG**M**	Management Sciences
9	PG**I**	Inter Disciplinary Technology Elective

7. Elective Courses

The lists of elective courses – grouped across depth and breadth categories – are presented below, showing credit hours and weekly contact hours.

Elective Breadth Courses				Weekly Contact Hrs.
Course Code	**Title**	**Knowledge Area**	**Credit Hrs.**	
PGT-222	▪ Petroleum Refinery Technology ▪ Reservoir Geomechanics ▪ Unconventional Resources ▪ Corrosion Control Technologies ▪ Sustainable oil & gas Technology ▪ Offshore Technology ▪ Well Stimulation Techniques ▪ Artificial Lift Technology ▪ Non-Destructive Testing	Petroleum & Gas Engineering Technology Breadth Elective-I	2+1	2+3
PGT-312		Petroleum & Gas Engineering Technology Breadth Elective-II	2+1	2+3

Elective Depth Courses				Weekly Contact Hrs.
Course Code	**Title**	**Knowledge Area**	**Credit Hrs.**	
PGT-313	▪ Surface Petroleum Operations ▪ Oil Field Chemistry ▪ Well Control Techniques ▪ Drilling Fluid hydraulics ▪ Petrochemical Waste Management ▪ Petroleum Resources & Reserves Estimation ▪ Well Testing ▪ Principles of Enhanced Oil Recovery ▪ Gas Processing Technology ▪ Flow Assurance ▪ Flow In Porous Media ▪ Gas Reservoir Engineering ▪ Instrumentation and Process Control	Depth Elective-I	2+1	2+3
PGT-322		Depth Elective-II	2+1	2+3
PGT-323		Depth Elective-III	2+1	2+3
PGT-411		Depth Elective-IV	2+1	2+3
PGT-412		Depth Elective-V	2+1	2+3
PGT-413		Depth Elective-VI	2+1	2+3
PGT-414		Depth Elective-VII	2+1	2+3
PGT-415		Depth Elective-VIII	2+2	2+6

8. Course Contents

The primary goal of this curriculum is to be substantially in compliance with international standards set by relevant agencies such as the International Engineering Alliance (IEA) and the Sydney Accord.

Program Learning Objectives (PLO's), Course Learning Objectives (CLO's) and Bloom's Taxonomy Levels are expected learning outcomes and are aligned to standards set by the Sydney Accord and the IEA.

Course Content

8.1 Islamic Studies/Social Ethics

CODE & TITLE (PGH-111/112) **Islamic Studies/Social Ethics**		CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Art & Humanities-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Recite** Holy Quran with correct pronunciation.	C-1	11
CLO-2	**Apply** understanding of basic concepts of teaching of Islam (faith, pillars, Dawit, preaching and Seerat).	C-3	11
CLO-3	**Understand** compilation of the Holy Quran and Basic Concepts of Hadith.	A-2	11
CLO-4	**Present** Islam as a complete code of life.	A-3	9

Course Outline

History of Islam: Compilation of the Holy Quran and Hadith, Fundamental doctrines of Islam i.e., Tawheed, oneness of Allah, Prophet hood, the day of Judgment, Revealed books, Ibadaat (worship) Philosophy of Ibadaat, Namaz, Zakat, Hajj & Sawm, Importance of preaching of Islam, its needs and effects, Difficulties in the ways of preaching of Islam, sectarianism, its causes and effects in Muslim society, definition of Right, classification of Right, importance of Rights, Khutba Hajjatul Wida (last address of the Holy Prophet, peace be upon him), Seeratun-Nabi (Peace be upon him).

Life of Holy Prophet (Peace be upon him): The life of the Holy Prophet before and after prophet hood. The Hijra (Migration to Madina), Treaty of Al Madina, Makki and Madani life of Holy Prophet Muhammad (Peace be upon him), importance of peace and causes of terrorism.

Islam and Civilization: Definition of civilization, Impacts of Islamic civilization on the Sub-continents, international impacts of Islamic civilization, Impacts of Human thoughts, social and humanistic effects, Importance of Ethics, Human rights (Hoqooq Ul Ibad) with detail.

Knowledge and Islam: Definition of Knowledge, Classification of knowledge, Importance of technology in the light of Holy Quran and Sunnah, relevant verses of the Holy Quran about Technology (Baqara 28,30,33,201, Nahal:76, Jasia: 13, Araf: 32, Noor: 55 etc), Islamic and scientific knowledge.

Recommended Books
A Guidebook for Muslims, by Syed. Abul Hasan Ali Nadvi.
An Introduction to Islam, by Dr. Muhammad Hameedullah.
What is Islam? by Maulana Manzoor Nomani.
Islamiat (A standard book for CSS), Prof. Dr. Arif Naseem.

Course Content

8.2 Pakistan Studies

COURSE CODE & TITLE (PGH-121) **Pakistan Studies**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Art & Humanities-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** differences between ideological and non-ideological states.	A-1	6
CLO-2	**Discuss** Pakistan Movement, and political and constitutional history of Pakistan.	A-3	11
CLO-3	**Understand** current issues of Pakistan, their causes and solutions.	A-4	11

Course Outline for Theory

Pakistan ideology: Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah, Aims and objective of the creation of Pakistan. Indus Civilization, Location and Geo-Physical features, Reformist Movement in Subcontinent. Muslim League 1906, Lahore Resolution 1940, 3rd June plan and Independence 1947, Constitution and Law, Constitutional Assembly, Nature and Structure of Constitution, Features of 1956, 1973 Constitutions. Amendments in the Constitution (17th, 18th, 19th and 20th), Foreign Policy, Objectives, Contemporary Pakistan, Economic institutions and issues, Society and social structure, Ethnicity, Determinants of Pakistan Foreign Policy and challenges, Futuristic stance of Pakistan

Recommended Books

Amin, Tahir. Ethno – National Movement in Pakistan, Islamabad: Institute of Policy Studies, Islamabad.

Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research,

Struggle for Pakistan by Mr. Ishtiaq Hussain Qureshi

Course Content

8.3 Communication Skills

CODE and TITLE (PGE-111) **Communication Skills**		CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Expository Writing-I**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the importance and basic concepts of communications.	A-1	9
CLO-2	**Identify** common errors made by learners of English as a second language.	A-2	9
CLO-3	**Communicate** effectively through technical writing and presentations, and develop understanding of communication skills essentials, using basic- to-intermediate level English.	A-3	9

Course Outline

Vocabulary building, common writing errors, purposeful writing, business writing, critical reading, reading for understanding, introduction to communication process, seven Cs of communication, types of listening, listening skills, verbal and non-verbal communication, basic presentation skills, Presentation Strategies and public speaking skills, use of Audio-Visual Aids, basics of group communication, communicate effectively in job interviews.

Recommended Books

Practical English Grammar, by A. J. Thomson and A. V. Martinet. Fourth edition. Oxford University Press.

Practical English Grammar Exercises 1, by A. J. Thomson and A. V. Martinet, Oxford University Press.

A Practical Guide to Business Writing: Writing in English for Non-Native Speakers, by Khaled Mohamed Al Maskari. Wiley.

Communication Skills for Engineers, by Sunita Marshal and C. Muralikrishna

The Essentials of Technical Communication, by Elizabeth Tebeaux and Sam Dragga, Oxford University Press.

College Writing Skills, by John Langan,. 9th Edition

Exploring the World of English, by Saadat Ali Shah, Ilmi Kitab Khana.

Course Content

8.4 Technical Report Writing

COURSE CODE & TITLE (PGE-211) **Technical Report Writing**	**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Expository Writing-II**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Discuss** basic concepts in technical writing, and use of standard word processing software, along with referencing tool for report writing.	A-2	5
CLO-2	**Write** technically correct statements, assignments, final year project reports, project proposals, short reports, research papers, and business and professional correspondence.	A-3	9
Course Outline for Theory			
Introduction to technical writing, technical communication process, proposal write-up and improvement strategies, introduction to research and research types, choosing research problems and research advisors, how to carry out research, different parts of technical writing, formulation – problem statement, literature review, design – methodology, analysis - data analysis and interpretation good writing style techniques, uses of correct words, presenting and publishing research, write business/professional correspondence, cover letter and CV, writing meeting minutes, introduction to informal writing, uses of informal reports.			
Recommended Books			
Technical Report Writing Today, by Daniel Riordan, 10th Edition Technical Writing and Professional Communication, Leslie Olsen and Thomas Huckin, 2nd Edition. Communication for Engineering Students by J. W. Davies, Science Research Writing for Non-Native Speakers of English by Hilary Glassman-Deal, Imperial College Press.			

Course Content

8.5 Calculus and Analytical Geometry

COURSE CODE & TITLE (PGQ-111) **Calculus and Analytical Geometry**	**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Quantitative Reasoning-I**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** ideas of rate of change, derivatives, and their basic applications.	C-2	1
CLO-2	**Apply** integration techniques for solving and analyzing problems in integral calculus.	C-3	2
CLO-3	**Describe** vector calculus and analytical geometry in multiple dimensions for investigation of different engineering problems.	C-2	2

Course Outline for Theory

Basic definition of derivative, differentiation of different functions, rule of differentiation, chain rule implicit differentiation, Applications: slope, equation of tangent and normal. maxima, minima and point of inflection. Indefinite integral, different technique or integration i.e. integration by parts, integration by substitution, by partial fraction, integration of different trigonometric identity. Define definite integral: Application of definite integral, i.e., Area under the curve. Area between the curve, mean value theorem, finding the volume by slicing, volume of solid revolution Disk and Washer method, moment and center of mass etc. Vector in space, vector calculus, Divergence, curl of vector field, Directional derivatives, multivariable function Partial derivatives, Spherical, polar, cylindrical coordinates. Vector in plane: Dot product and cross products, line and plane in space. Application: work, angle between two vectors, Area of triangle, Area of parallelogram etc.

Recommended Books

H. Anton, I. C. Bivens, S. Davis, "Calculus, Early Transcendental", 11th edition, John Wiley, New York, 2016.

Essential Calculus by James Stewart, 2nd Edition

G. B. Thomas, A. R. Finney, "Calculus", 14th edition, Pearson, USA, 2017.

S.M Yousaf, "Calculus and Analytic Geometry".

Advanced Engineering Mathematics by Erwin Kreyszig, 10th Ed. Willey 2014.

Course Content

8.6 Differential Equations

COURSE CODE & TITLE (PGQ-121) **Differential Equations**		**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Quantitative Reasoning-II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** differential equations, and solutions of first and higher orders homogenous and non-homogenous differential equations by appropriate methods.		C-2	1
CLO-2	**Solve** linear differential equations using the Laplace Transform technique and power series methods.		C-4	1
Course Outline for Theory				
Basic concept of differential equation, I.e., Definition, order, degree, and geometric meaning of Diff: equation. Solution of First order Diff Equation: Separable of equation, Exact Diff: Equation, integrating Factor, Linear ODEs. Second and higher order Differential Equation: Homogenous linear ODE with constant coefficient, Cauchy Euler Equation. Non homogenous Equation by undetermined coefficient, by variation of parameter and similar higher order Diff. equation. Finding Laplace and inverse Laplace of different functions, S- shafting theorem, solution of differential equation using Laplace transform. Basic concept of power series, Radius of convergence, convergence interval, using power series method to find the solution of Differential Equation.				
Recommended Books				
Advanced Engineering Mathematics by Erwin Kreyszig, Willey 2014. W. E. Boyce, R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems, 10th edition", John Wiley & Sons, Inc., 2012. D. G. Zill, M. R. Cullen, "Differential Equations with Boundary-Value Problems", 10th edition, Brooks/Cole, 2013.				

Course Content

8.7 Linear Algebra

COURSE CODE & TITLE (PGQ-211) **Linear Algebra**		**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Quantitative Reasoning-III**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** basic definitions, properties, and theorems of linear algebra.		C-2	1
CLO-2	**Illustrate** matrix operations to solve systems of linear equations.		C-2	1
CLO-3	**Apply** linear transformations and applies matrix theory to model real-life situations.		C-3	1

Course Outline for Theory

System of linear equations, row reduction and echelon forms, vector equations, the matrix equation ax=b. Solution sets of linear systems, applications of linear systems. Concept of matrices, types of matrices, operation on matrices i.e., addition, subtraction, multiplication, properties of matrix operation, the elementary row operation, echelon form, solution of linear system of equation by gauss elimination method, concept of consistent and inconsistent solution, polynomial interpolation. inverse of matrix using Gauss-Jordon method. Determinant of matrix: definition and properties of determinants and their theorem, concept of singular and nonsingular matrix, solution of non-homogenous linear system of equation using Cramer's rule. Introduction to linear transformation, daily life application i.e., cryptography example coding and decoding the messages, computer graphic.

Recommended Books

Introductory Linear Algebra by Bernard Kolman

Advanced Engineering Mathematics by Erwin Kreyszig, 10th Ed. Willey 2014.

D. C. Lay, S. R. Lay, J. J. McDonald, "Linear Algebra and Its Applications", 5th Edition, Pearson Education, 2015.

Linear Algebra and its Applications by Gilbert Strang, 4th Edition,

Course Content

8.8 Professional Ethics

COURSE CODE & TITLE (PGH-221) **Professional Ethics**		**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Social Science-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the profession, professional ethics, moral and social issues: The importance of values and professional ethics in personal and professional lives, and consequences of acting unethically in an organization or society.		C-1	7
CLO-2	**Understand** various roles of engineering technologist in applying ethical principles at various professional levels.		A-3	6
CLO-3	**Resolve** the ethical dilemmas using common ethical values and identify possible actions to be taken in response.		A-5	7

Course Outline for Theory

Introduction: Introduction to ethics, personal and professional ethics, the nature of engineering ethics; legal, professional and historical definitions; origin of professional ethics, profession and professionalism; professional accountability, professional success, professional risks, professional associations; benefits of acting ethically and consequences of acting unethically. Value of Ethics: Values in professional ethics, central responsibility of engineering professionals, ethics in different fields of work, SPE code of ethics, ethical code for engineering professionals, global issues in professional ethics, ethics in manufacturing and marketing, intellectual property rights, business ethics and corporate governance. Ethical Dilemmas: Common ethical dilemmas, resolution of ethical dilemmas, possible actions in response to dilemmas, probable consequences of these actions.

Recommended Books

Engineering Ethics Concepts & Cases by Charles E Harris, 5th Edition, Cengage 2014,

Kenneth Blanchard, Professional Ethics, 4th Edition

Ethics in Engineering 4th edition, by Mike W. Martin, Roland Schinzinger, McGraw-Hill, New York, 2005.

The Seven Habits of Highly effective people by Stephan r. Covey

Engineering Ethics: Concepts and Cases, 4th edition, by Charles E. Harris, Michael S. Pritchard, Michael J. Rabins, Wadsworth, 2008

Professional Ethics: R. Subramanian, Oxford University Press, 2015.

Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015.

Course Content

8.9 Applied Chemistry

COURSE CODE & TITLE (PGN-112) **Applied Chemistry**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Natural Science-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** basic theories, terms, and concepts applicable in the field of Petroleum Engineering Technology.		C-1	1
CLO-2	**Deliberate** upon various types of materials, chemical properties, phases, chemical processes, and their quantitative analysis.		C-2	2
CLO-3	**Have** skills to solve problems related to Petroleum Engineering Technology.		C-2	3
Lab Work Learning Outcome				
CLO-1	**Perform** chemical lab experiments associated with oil and gas technology.		P-3	4
CLO-2	**Participate** as an individual and as a group member in the lab related activities.		A-2	9
CLO-3	**Report** summarized experimental data and results.		A-2	10
Theory Course Outline				
Introduction to Chemistry. State and properties of matter. Properties of solid, liquid, and gases. Modern Periodic table and classification of elements. Basic laws and principles, Physical principles involved in the study of properties of metals and nonmetals. Solution and solubility. Raoult's Law, Henry's law, Law of diffusivity. Theory of crystallization, chemical kinetics. Viscosity, vapor pressure, Chemistry of solutions, azeotropic solution, vapor pressure, distillation of partially miscible and miscible liquids, diffusion, osmosis, theory of dilute solutions, relation with vapour pressure. Chemical equilibrium. Organic Chemistry. Chemistry of hydrocarbon compounds, their structures, reactions and preparation. Cracking. Polymerization. Organic reactions. Analytical Chemistry. Introduction to analytical instrumentation. Concept of accuracy of analysis, separation techniques including gas chromatography, geochemistry, Gas chromatography. Basics of spectroscopy, UV and visible spectroscopy b. Basics of Mass spectrometry and its application to petroleum products. Geo-chemical classification of elements, Chemical weathering geo-chemical				

description, Geo-chemical prospecting, significance, and techniques. Electrochemistry (Electrolysis, electrolytic conductance, transport number and transport phenomena determination of transport number). Potentiometric titrations, ph, buffer solution, acid base indicators. Surface tension, interfacial tensions, surface films surface active agents.
Lab course outline
Determination of Heat of Solution of a given salt solution. Determination of the Heat of Neutralization of given Acid-Base pair. Determination of the Surface Tension of a given Liquid by using Stalagmometer. Determination of Viscosity (absolute and relative) of a given liquid by using Ostwald's Viscometer. Determination of the percentage composition of colored ions by using Photoelectric Colorimeter. Determination of the percentage composition of two liquids by viscosity. Determination of the percentage composition of two liquids by Refractive Index. Determination of the strength of Acid/base by pH-Metric Titration. Determination of the Molecular weight of a given substance by Depression in Freezing Point (Cryoscopic) methods. Determination of Transition Temperature of a substance by thermometric method. Determination of the Molecular weight of a given substance by Elevation of Boiling Point (Ebullioscopic) methods. Determination of adsorption of a solute by activated charcoal. Determination of the strength of Acid/base by Conductometric Titration. Preparation of Buffer solutions of various pH ranges (by pH-metric methods)
Recommended Books
1. Dennis G. Zill, Warren S Wright, "Differential equations with Boundary-Value Problems", 8th Edition, Cengage Learning, 2012. 2. John Warren Dettman," Introduction To Linear Algebra And Differential Equations", Mcgraw-Hill Kogakusha - Tokyo, 1974 3. Erwin Kreysizg, "Advanced Engineering Mathematics", ISBN: 9780470458365 4. Carey, Francis A. Organic chemistry, 4th ed., published by McGraw Hill in 2000. 5. Relevant updated research articles

Course Content

8.10 Economics for Technologist

COURSE CODE & TITLE	CREDIT & CONTACT HOURS	KNOWLEDGE AREA/ DOMAIN
(PGM-311) **Economics**	(3+0) **48 Theory + 0 Lab**	**Management Science-I**

	After completion of this course, students will be able to:	Bloom's Taxonomy Level	PLO
CLO-1	**Estimate** depreciation of an asset using standard depreciation techniques to assess its impact on present or future value.	C-2	10
CLO-2	**Predict** cost effectiveness of individual projects using the methods learnt, and effects of inflation on economic analysis of engineering technology projects.	C-3	6
CLO-3	**Apply** appropriate engineering technology economics analysis method(s) for problem solving i.e., present worth, annual cost, rate of return, payback, break-even, benefit-cost ratio.	C-4	10

Course Outline for Theory

Basic concepts, technological economy defined Types of Business organizations, financial statements and financial ratios, Time value of money, cash flow series and its types, basic cost concepts. Profit and interest, discrete and continuous compounding, nominal, and effective interest rate. Economic analysis of alternatives, Alternatives having identical lives, Alternatives having different lives, Present value (PW), Alternative value (AW), future value (FW), Cost-benefit analysis and rate of return analysis, Break-even and payback analysis. Use of spreadsheets for economic analysis, economic effects of inflation. Replacement and retention decisions Depreciation, amortization, and depletion of economic resources. Price, Supply and Demand Relationship. Project financing. Factors of production, Capital budgeting, economic analysis in the service sector.

Recommended Books

Technological Economics by Shoubo Xu (Springer),

Engineering Economy, Leland T. Blank and Anthony J. Tarquin, McGraw Hill,

Contemporary Engineering Economics, Chan S Part Pearson Prentice Hall

Engineering Economic Analysis by Donald G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, 12th edition, Oxford University Press,

Course Content

8.11 Entrepreneurship

COURSE CODE & TITLE (PGM-312) **Entrepreneurship**		**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Management Science-II**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** entrepreneurship concept, and the role of entrepreneurship in economic development.		A-3	10
CLO-2	**Compare** the role and importance of the small and medium sized enterprises in the economy.		A-4	6
CLO-3	**Identify** an attractive market, and apply business planning concepts for new business creation and growth.		A-3	8

Course Outline for Theory

The concept of entrepreneurship, the economic view of entrepreneurship, the sociologist view, Behavioral approach, Entrepreneurship and Management. The process of entrepreneurship, Entrepreneurial Management, The entrepreneurial business, Entrepreneurship in service institutions, the new venture. The innovation concepts, Importance of innovation for entrepreneurship, Sources of innovative opportunities, the innovation process, Risks involved in innovation. Entrepreneurial profile, Trait approach to understanding entrepreneurship, Factors influencing entrepreneurship, the environment, Socio cultural factors, Support systems. Teamwork, Networking organization, Motivation and compensation, Value system. Defining SMEs, Scope of SMEs, Entrepreneurial, managers of SME, Financial and marketing problems of SMEs, Framework for developing entrepreneurial marketing, Devising entrepreneurial marketing plan, Entrepreneurial marketing strategies, Product quality and design, Role of entrepreneur in the economic development generation of services, Employment creation and training, Ideas, knowledge and skill development, The Japanese experience, Case Studies of Successful Entrepreneurs

Recommended Books

Technology Ventures: From Idea to Enterprise by Thomas Byers, Richard Dorf, Andrew Nelson, 4th Edition, McGraw Hill 2015,

Paul Burns and Jim Dew Hurst: "Small Business and Entrepreneurship", 1996, Palgrave Macmillan Publishing Company, Second Edition

Peter F. Drucker: "Innovation and Entrepreneurship", 2006, Harper Business, Reprint Edition

The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company by Steve Blank, Bob Dorf, K & S Ranch 2012,

The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries, Penguin Books 2011,

John B. Miner, "Entrepreneurial Success", 1996, Berrett-Koehler Publishers, First Edition

Course Content

8.12 Leadership and Personal Grooming

COURSE CODE & TITLE (PGH-221 / PGM-221) **Leadership and Personal Grooming**		**CREDIT & CONTACT HOURS** (2+0) **32 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Social Science-II /** **Management Sciences-III**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the concepts of leadership, management, and human resources.		C-2	11
CLO-2	**Demonstrate** individual and team grooming, with joint work studies.		C-3	9

Theory Course Outline

Introduction to Leadership, administration and organization, the difference between administration and Management., types of leadership, Important levels of Leadership; Leadership by objectives Leadership and organization structure, Types of organization, Organization behavior, Organization chart, Definition, concepts, objectives and functions of personnel management, Recruitment and selection procedures, personnel policy; Centralization and manpower planning, wages and salaries, Administration, life insurance and company insurance; Strategic human resource planning; Project management, Labor laws prevent and settlements of dispute technique.

Communication skills, leading under pressure, Time management, Conflict resolution, Employee engagement, Motivating and influencing your teams, Effective feedback, Delegation, Different Leadership Styles, Diversity and Inclusion, Change Management Goal Setting, leading vs. Managing, Project Planning, Managing Effective Meetings, Accountability, Collaboration and Teamwork

Recommended Books

1. Flynn, G. ed., 2022. Leadership and business ethics (Vol. 60). Springer Nature.
2. Karnes, F.A. and Bean, S.M., 2021. Leadership for students: a guide for young leaders. Routledge.
3. Akshay, K., 2021. TLP for Personal Grooming & Effectiveness 2020-2021.
4. Askeland, Harald, Gry Espedal, Beate Jelstad Løvaas, and Stephen Sirris. Understanding values work: Institutional perspectives in organizations and leadership. Springer Nature, 2020.

Course Content

8.13 Computer Fundamentals

COURSE CODE & TITLE (PGC-111) **Computer Fundamentals**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computing-I**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** the working of computer hardware and software systems.		C-1	1
CLO-2	**Use** the concepts of data communication and networks.		C-3	3
Lab Work Learning Outcome				
CLO-1	**Recognize** the working of hardware components of a computer.		P-1	4
CLO-2	**Participate** as an individual and as a group member in the lab related activities.		A-2	9
CLO-3	**Report** summarized experimental data and results.		A-2	10
Theory Course Outline				
Introduction to Computers; Generations of computers, Application areas of computer, Information/Data Processing Cycle, Number systems (Binary, Octal, Decimal, Hexadecimal), Input, output and peripheral Devices, Computer Memory: RAM (Random-Access Memory), ROM (Read-Only Memory); Primary, cache memory, Secondary storage: Magnetic, Optical and solid state, Units of memory measurement, Basic CPU (Central Processing Unit) organization, Parts of CPU: ALU (arithmetic-logic unit), CU (Control Unit), FPU (Floating Point Unit) and Registers. Computer software and its types.				

Lab course outline
Familiarize students with basic computer hardware and software Familiarize C and exploring Turbo C IDE Variables (declaring and assigning values to variables), Displaying output to the user (printf), Receiving input from the user (scanf) Arithmetic Operators (multiplication, division, modulus, addition and subtraction) Relational and logical operators (less than or equal to, greater than or equal to, greater than, less than, equal to and not equal to), Decision or selection statements (if, if-else, switch)
Recommended Books
1. Robert Lafore, "Waite Group's Turbo C Programming for the PC", Rev Sub Edition, Financial Times Prentice Hall, 1988. 2. Peter H. Salus, "Programming Languages Handbooks Manuals, Object Oriented Programming Languages Handbooks Manuals, Techmedia – New Delhi, 1998. 3. Yashavant P. Kanetkar, "Let Us C", Infinity Science Press, 2008, 9781934015254. 4. Data Structures and Algorithm Analysis in C++", by Mark Allen Weiss, 2nd edition, Addison Wesley. ISBN 0-201-36122-1.

Course Content

8.14 Computer Programing & Software Application

CODE & TITLE (PGC-111) **Computer Programing & Software Application**		**CREDIT & CONTACT HOURS** (1+1) **16 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computing-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the fundamental concepts of computing and basic computer programming.	C-1	1
CLO-2	**Explain** programming algorithms and flow charts.	C-2	3
CLO-3	**Solve** common petroleum engineering technology problems, using basic programming applications .	C-3	4
Lab Work Learning Outcome			
CLO-1	**Perform** the computer and software lab tasks associated with oil and gas technology.	P-3	4
CLO-2	**Participate** as an individual and as a group member in the lab related activities.	A-2	9
CLO-3	**Report** summarized experimental data and results.	A-2	10
Theory Course Outline			
Introduction to Digital Computer Hardware (Memory Allocation). Elements of Programming. Programming Languages. Problem analysis. Flow charts with algorithms. Programming Examples and Exercises using C/C++ language (or any latest programming languages) with application to Engineering technology Problems. Debugging Techniques.			

Lab course outline
Familiarize students with basic computer hardware and software Familiarize C and exploring Turbo C IDE Variables (declaring and assigning values to variables), Displaying output to the user (printf), Receiving input from the user (scanf) Arithmetic Operators (multiplication, division, modulus, addition and subtraction) Relational and logical operators (less than or equal to, greater than or equal to, greater than, less than, equal to and not equal to), Decision or selection statements (if, if-else, switch) Repetition statements (For Loop and nested For Loop) Repetition statements (While, do-while, nested while loop), break and continue statements Functions, call by value, call by reference Arrays, adding values to an array, retrieving values from array Pointers (referencing, dereferencing) Strings (declaration and initialization of string array, string comparison, concatenation of strings, copying one string into another) Storage classes, global static variables Structures, declaration and initialization of structures, structure's members Arrays of structures (declaration, initialization and retrieving values from array of structure) File Handling (open, reading and writing a file)
Recommended Books
5. Robert Lafore, "Waite Group's Turbo C Programming for the PC", Rev Sub Edition, Financial Times Prentice Hall, 1988. 6. Peter H. Salus, "Programming Languages Handbooks Manuals, Object Oriented Programming Languages Handbooks Manuals, Techmedia – New Delhi, 1998. 7. Yashavant P. Kanetkar, "Let Us C", Infinity Science Press, 2008, 9781934015254. 8. Data Structures and Algorithm Analysis in C++", by Mark Allen Weiss, 2nd edition, Addison Wesley. ISBN 0-201-36122-1.

Course Content

8.15 Application of Reservoir Simulation

CODE & TITLE (PGC-321) **Application of Reservoir Simulation**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Computing-II**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** the basic concepts of reservoir simulation.	C-1	1
CLO-2	**Compute** fluid flow equations in porous media.	C-3	2
CLO-3	**Analyze** the concepts of reservoir engineering technology and reservoir simulation for petroleum field development through relevant software.	C-4	4
Lab Work Learning Outcome			
CLO-1	**Apply** the concepts of reservoir engineering and reservoir simulation for petroleum field development through relevant software.	P-1	4
CLO-2	**Participate** as an individual and as a group member in the lab related activities.	A-2	9
CLO-3	**Report** the summarized experimental data and results.	A-2	10
Theory Course Outline			
Introduction to the concepts of reservoir simulation, its advantages, and limitations. Revision of basic reservoir engineering technology concepts, reservoir fluid and rock properties and basic mathematical concepts. Formulation of basic equations for single-phase flow in porous media, finite difference approximation to flow equations, stability, and error analysis. Partial differential equations (PDE's) for one-phase and multi-phase flow in porous materials, and numerical methods for solving these. Well representation in simulators, solution of linear difference equations applicable to the reservoir using direct and iterative methods. Compositional reservoir simulation models with applications within different gas injection processes. Water-based models for polymer flooding and tracer techniques. Models for fractured reservoirs. Discussion of different types of reservoir simulation models; practical sides of reservoir simulation applications.			

Lab course outline
To demonstrate features, options and sections of eclipse reservoir simulator by Schlumberger. To specify the model of dead oil reservoir through case definition (RUNSPEC) section of Eclipse 100 (Black oil Simulator). To create static grid model of dead oil reservoir through Grid section of Eclipse 100 (Black oil Simulator). To import, monitor and view (3D & 2D) data file of static grid model of dead oil reservoir through Eclipse office (Reservoir Simulation Manager). To assign fluid properties function of pressure in a model of dead oil reservoir through Props section of Eclipse 100 (Black oil Simulator). To assign petro physical properties of rock & fluid in a model of dead oil reservoir through Props section of Eclipse 100 (Black oil Simulator). To create regions in a model of dead oil reservoir through region section of Eclipse 100 (Black oil Simulator). To monitor the Regions of 3D static grid model of dead oil reservoir by importing TUT1A.data file in previous experiment through Eclipse office (Reservoir Simulation Manager). To initialize the model of dead oil reservoir at initial (equilibrium) conditions through Solution section of Eclipse 100 (Black oil Simulator). To demonstrate output variables of the model of dead oil reservoir for performance analysis through Summary section of Eclipse 100 (Black oil Simulator).
Recommended Books
1. Turgay Ertekin, Jamal H. Abou-Kassem, Gregory R. King, “Basic Applied Reservoir Simulation”, Vol. 7, Society of Petroleum Engineers Richardson Texas,2001. 2. M. R. Carlson, “Practical Reservoir Simulation”, Edition illustrated, Pennwell Books-Tulsa, Oklahoma, 2003. 3. Calvin C. Mattax and Robert L. Dalton, “Reservoir Simulation”, Vol. 13, Society of Petroleum Engineers Richardson Texas, 1990. 4. Donald W. Peaceman, “Fundamentals of Numerical Reservoir Simulation”, ISBN: 0444552987 5. Calvin, C. Mattax, “Reservoir Simulation”, ISBN: 1555630286. 6. Henry B. Crichlow, “Modern Reservoir Engineering: A Simulation Approach” ISBN: 0135974682. 7. John R. Fanchi, “Principles of Applied Reservoir Simulation”, ISBN: 0750679336 8. Gordon W. Thomas, “Principles of Hydrocarbon Reservoir Simulation”, ISBN: 0137111770

Course Content

8.16 Project Part-I

COURSE CODE & TITLE (PGT-314) **Project Part-I**		**CREDIT & CONTACT HOURS** (0+3) **0 Theory + 144 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology Domain Project**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify,** and apply background knowledge of engineering technology fundamentals to the proposed project-idea and compare with other related projects.		C-3	1
CLO-2	**Analyze** the problem statement through research and literature review.		C-4	2
CLO-3	**Defend** the impact of proposed idea in societal and environmental contexts and demonstrate knowledge of sustainable development.		C-5	10
CLO-4	**Develop** a wide range of technical skills and latest design tools to develop a working prototype, that has passed through the design, implementation, testing and evaluation stages.		C-6	3
CLO-5	**Identify** solutions to Complex Engineering Technology Problems for improvement of society or the environment.		A-4	7
CLO-6	**Practice** various methods using ethical values to avoid plagiarism in report writing.		A-5	7
CLO-7	**Effectively** manage individual and team effort.		A-4	8
CLO-8	**Demonstrate** communication skills through presentations, technical reports, and posters.		A-5	9
CLO-9	**Display** the results of hardware components testing which could be used for oil and gas companies.		P-5	5

Course Content

8.17 Project Part-II

COURSE CODE & TITLE (PGT-324) **Project Part-II**	**CREDIT & CONTACT HOURS** (0+3) **0 Theory + 144 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology Domain Project**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Devise** an experimentally verified system which can solve a Broadly Defined Engineering Technology Problem.	C-6	3
CLO-2	**Implement** proposed design using modern technology for solution of Broadly Defined Engineering Technology Problem.	C-3	5
CLO-3	**Investigate** and analyze the results obtained from the implemented design.	C-4	4
CLO-4	**Practice** ethical principles (Plagiarism in particular) and follow engineering technology norms.	A-5	7
CLO-5	**Display** effectiveness as an individual and in a teamwork setting.	A-4	8
CLO-6	**Display** communication skills through presentations, technical reports, and posters.	A-5	9
CLO-7	**Demonstrate** management skills as a member or leader to manage the project.	A-4	10
CLO-8	**Revise** conventional solutions by adapting modern technology.	P-6	11

Course Content

8.18 Workshop Technology

CODE & TITLE (PGT-111) **Workshop Technology**	**CREDIT & CONTACT HOURS** (0+2) **0 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Foundation)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the function of different hand tools and instruments used during workshop practices.	C-2	1
CLO-2	**Design** and fabricate different mechanical components using available fabrication tools.	P-3	5
CLO-3	**Follow** general, and experiment specific, safety guidelines.	A-2	6

Course Outline

Machine Shop: Learn to operate lathe, milling, drilling, cutting, grinding and make a work piece; Further work on the lathe including drilling from the tailstock, boring in chuck and holding work on faceplat; Introduction and demonstration on the million machines, methods of holding work, use of dividing head; From cutting of involutes gear and generation of spiral; Study of universal tool cutter grinding machine, use of gauges.

Fitting Shop: Make a small hand tool, including marking out from blue-print, filing to size, and punching marks; The making of a small hand tool, involving marking out from blue-print and filling to size; Use of surface place and surface gauge; Measurement by micrometer or Vernier caliper; Stripping down a small assembly to examine its needs for repair and its re-erection. Basic knowledge of limits and Fits system.

Electrical Shop: Wiring of circuit to a blueprint; Make an electric circuit work piece; Study of wiring circuit of a mechanically propelled vehicle; Connection of single and three phase motors, battery and its charging.

Carpentry and Pattern Shop: Introduction to pattern making practice; Different types of patterns; Shrinkage and other allowance; Preparations of a pattern with core print and core box; Wood turning practice; Make a wooden work piece from blue print of a given design specifications.

Smithy and Foundry Shop: Introduction and use of moulding / moulder's tools; Preparation of a mould and a core; Method of melting/shaping metals;Making of a casting from a simple pattern in either ferrous or non-ferrous metal.

Welding: Fabrication exercises in electrical and gas welding; Inspection of welding joints steel metal work.

Recommended Books
Adam Wire, 5 Essential Electrician Tools to Amp Up Your Tool Belt, 2020 Amin ur Rasheed Noordin, Proteus professional Design, 2011 K.C. John, “Mechanical Workshop Practice”, Second Edition, Prentice-Hall of India Pvt. Limited, 2010

Course Content

8.19 Applied Thermodynamics

CODE & TITLE (PGT-121) **Applied Thermodynamics**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Foundation)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understanding c**onceptually applied thermodynamics processes, laws, and cycles.	C-2	1
CLO-2	**Apply** the concepts of thermodynamics on different numerical problems.	C-3	2
CLO-3	**Analyze** the principles of different phase equilibrium (PVT) in systems.	C-4	4
Lab Work Learning Outcome			
CLO-1	**Perform** the various experiments related to the thermodynamics.	P-5	4
CLO-2	**Participate** as an individual and as a group member in the lab related activities.	A-2	9
CLO-3	**Effectively** communicate the experimental results.	A-2	10
Theory Course Outline			
Introduction to thermodynamic: systems and processes, equilibrium, thermodynamic variables, intensive and extensive variables, thermodynamic properties, state functions, derived intensive variables, Types of work, kinetic and potential energy, **Laws of thermodynamics**: first law of thermodynamics: Internal energy, energy transfer by heat, energy balance, energy analysis of cycles. Second law of thermodynamic: entropy, entropy balance, ideal work, work lost, Quasi-static processes, reversibility, heat capacities, Applications to flow processes, nozzles, turbines, compressors, Heat Engines, Refrigeration and Air Conditioning, and Liquefaction of gases; Third law of thermodynamics			

Thermodynamic properties: Property relations relevant to applied thermodynamics, P-V-T relation, Phase diagrams, evaluating thermodynamic properties; relations for gas mixtures and multi-component systems, the Gibbs-Duhem relation, Phase equilibrium

Thermodynamic cycles: Gas power cycles, Vapor cycles, refrigeration cycles, Liquefaction

Lab course outline

Measurement of fluid properties: Density, Specific Weight, Specific Volume, Surface Tension, Viscosity

To examine the relation between temperature and pressure for saturated steam.

To produce energy balance for small steam plants.

To study the performance of small high-speed steam motor.

Calculation of coefficient of performance for the refrigeration machine

Study and operation of a vapor compression refrigeration unit.

Study and operation of Heating ventilation and air conditioning Unit (HVAC)

Recommended Books

Smith J.M., Van Ness H.C., Abbott M.M. “Chemical Engineering Thermodynamics” 8thEd. McGraw-Hill International Edition, 2005.

Daubert Thomas E. “Chemical Engineering Thermodynamics”, 1stEd., McGraw-Hill Book Company, 1985.

Sandler Stanley I. “Chemical and Engineering Thermodynamics” 3rdEd. John Wiley and Aons, Inc.

Moran M. J., Shapiro H. N., “Fundamentals of Engineering Thermodynamics” 6th Ed. John Wiley and Sons, Inc.

Cengel, Y. A., Boles, M. A., “Thermodynamics: An Engineering Approach”, , McGraw-Hill, 2008

Course Content

8.20 Environment & Safety Management

CODE & TITLE (PGT-221) **Environment & Safety Management**	**CREDIT & CONTACT HOURS** (2+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Foundation)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Comprehend** the various aspects of health, safety, and environment in petroleum industry.	C-2	6
CLO-2	**Apply** the concepts of environmental impact assessment techniques.	C-3	7
CLO-3	**Analyze** the principles of occupational accidents, and injury prevention.	C-4	`6

Course Outline

Environmental impact assessment of oil and gas field, risk securing techniques, concept of air and water pollution in petroleum industry, flaming impact, oil spill control, solid waste and sludge control, impact of drilling activity, emissions during drilling, production, storage and LPG plant operation, noise pollution in oil exploring and exploiting, prevention and control.

Occupational health and safety administration.

Design procedure for operation, maintenance, modification, and emergencies, safety by contractor, accident and incident reporting, investigation and follow-up, and reappraisal of the system.

The principles of EIA. Legislation and regulatory aspects of EIA.

Recommended Books

Jeremy W. Stranks," A Manager's Guide to Health and Safety at Work." Seventh Edition, Kogan Page, 2003.

Phil Hughes, Ed Ferrett," Introduction to Health and Safety at Work", Fourth Edition, Routledge, 2009

OSHA Regulations and Guidelines: A Guide for Health Care Providers. ISBN: 9780766804784.

Course Content

8.21 Fluid Mechanics

CODE & TITLE (PGT-123) **Fluid Mechanics**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Foundation)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the basic principles of fluid mechanics and its application on types of flows.	C-2	1
CLO-2	**Apply** the laws of conservation of mass, energy, and linear momentum, on steady state fluid flow problems in simple geometries.	C-3	2
CLO-3	**Compare** and classify different fluid flow operations and measurements .	C-4	4
Lab Work Learning Outcome			
CLO-1	**Perform** experiments related to fluid flow following the lab guidelines.	P-5	4
CLO-2	**Comply** with general and experiment specific safety guidelines.	A-2	6
CLO-3	**Report** experimental results with ethical responsibility.	A-2	8

Course Outline

Fluid Statics: pressure forces on surfaces, Pressure distribution, Head Calculations, pressure measuring devices, Buoyancy, Pressure in accelerated rigid body motions.

Nature of Flow: Laminar & Turbulent Flow, Compressible & Non-Compressible Bernoulli's equation and its applications; Continuity Equation, Energy Relationships & the Bernoulli equation, pressure terminology, diffusers and sudden expansion.

Momentum of a Flowing Fluid; Newton's 2nd law of motion & Momentum Balance, Calculations for Laminar & Turbulent pipe flow, nozzle flow & flow & another example.

Stress in Fluids; Viscosity, Newton's Law of Viscosity, Shear Stress Components, Newtonian and non-Newtonian flow

Flow of Incompressible Newtonian Fluids in Pipes & Channels Shear stress in a pipe, Friction factor & pressure drop, Losses in fittings and bend pipes, enlargements and contractions, friction in non-circular channels, Velocity distribution for turbulent flow in a pipe. Piping network analysis.

Flow measurement; Orifice meter, Venturi meter, Rota meter, Nozzle. Notch and Wier, Electromagnetic flow meter, Concept of centrifugal pumps; Centrifugal pump characteristics; NPSH and its application; concept of specific speed; similarity laws in centrifugal pumps; pumps in series and parallel; Positive displacement pumps, their classification, characteristics and selection; matching system characteristics with pump

characteristics.

Lab course outline

To determine the stability of floating bodies and measure the meta- centric height

To determine the magnitude of hydrostatic force and center of pressure

To validate the Bernoulli's theorem

To measure flow rate through pipe using venture meter and orifice meter

To measure flow rate in an open channel by Notch and to calibrate it

To determine the coefficient of discharge of an Orifice Meter.

To determine the coefficient of discharge of Notch (V, Rectangular and Trapezoidal types).

To determine the friction factor for the pipes.

To determine the coefficient of discharge of Venturi meter.

To determine the coefficient of discharge, contraction and velocity of an orifice.

To find critical Reynolds number for a pipe flow.

To determine the miner losses due to sudden enlargement, sudden contraction and bends.

To study Velocity, Viscosity and Pressure measuring device

Recommended Books

Yunus A Cengel and John Cimbala, Fluid mechanics Fundamentals and Application, McGraw Hill, 4th dition (2018)

Bruce R. Munson , Donald F. Young , Theodore H. Okiishi, Wade W. Huebsch "Fundamentals of Fluid Mechanics", 6th Edition, Wiley, 2010

Robert Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, "Transport Phenomena", 2nd Edition, John Wiley & Sons, 2007

Fanzini, J Band E J Finnemore, "Fluid Mechanics with Engineering Applications, 9th Edition, WCB/McGraw Hill, 1997

White, F M, "Fluid Mechanics" 4th Edition, McGraw Hill, 1999

Douglas J F, J M Gasiorek and J A Swaffield, "Fluid Mechanics" 2nd Edition, Longman Publishing Group

Course Content

8.22 Petroleum Geology

CODE & TITLE (PGT-124) **Petroleum Geology**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Foundation)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** basic principles of petroleum exploration and field development.	C-2	1
CLO-2	**Apply** the theories and methods associated with the petroleum technology in geology.	C-3	4
CLO-3	**Analyze** geological problems by integrating different types of data used in the oil industry.	C-4	5
Lab Work Learning Outcome			
CLO-1	**Perform** different experiments related to petroleum geology.	P-5	4
CLO-2	**Participate** as an individual and as a group member in the lab related activities.	A-2	9
CLO-3	**Report** experimental results by comparing with the latest development in the field.	P-2	12
Course Outline			
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, Classification of Folds, faults, joints and unconformities, Expression of the above features on geological field maps and construction of cross sections, Geological mapping and the application of photogrammetry, Geophysical exploration methods with emphasis on seismic survey**.,** History of exploration in Pakistan, Principles of Stratigraphy, Stratigraphy of Pakistan with special emphasis on salt range, Introduction to structural geology and its objectives, Interpretation of pore pressure and fracture gradient profiles from seismic data.			

Lab course outline
To find the porosity of the given sample using Gravimetric Method. To find the porosity of the given sample using Volumetric Method. To utilize the data for petroleum exploration using geological method To utilize the data for petroleum exploration using geophysical method To utilize the data for petroleum exploration using gravimetric method To analyze different stratographic structures on strips using microscope
Recommended Books
Robert J. Twiss, Eldridge M. Moores, “Structural Geology”, 2nd Edition, W. H. Freeman and Company, New York, 2007. Peter K. Link, “Basic Petroleum Geology”, Oil and Gas Consultants International - Tulsa, Oklahoma, 2001. Richard C. selley, “Elements of petroleum geology“, 2nd Edition, 1997 Richard H. Groshong, “3-D Structural Geology”, 2nd Edition, Springer, 2008. William Lowrie, “Fundamentals of Geophysics”, 2nd Edition, 2007

Course Content

8.23 Mechanics of Material

CODE & TITLE (PGT-112) **Mechanics of Material**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Foundation)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the fundamental concepts of stress and strain.		C-2	1
CLO-2	**Select** appropriate structural materials for various loading conditions.		C-4	2
CLO-3	**Solve** problems of stress and strain on different geometries and loading conditions.		C-3	4
Lab Work Learning Outcome				
CLO-1	**Perform** various experiments related to mechanics of material.		P-5	4
CLO-2	**Participate** as an individual and as a group member in the lab related activities.		A-2	9
CLO-3	**Effectively** communicate the experimental results.		A-2	10
Course Outline				
Types of stress and strains.**,** Load extension diagrams. Hook's Law, Temperature stresses, Geometrical properties of plane areas. (Centroid, Moment of Inertia, and product of Inertia) Theory of simple Bending and Shearing in beams. Theory of Torsion in circular shafts (solid and hollow). Short Columns. Combined bending and direct stresses. Euler's Theory of buckling for long Column-Empirical formula. Mechanical properties of metals and timber in tension				
Lab Course Outline				
To Study the instruments related to mechanics of material. To perform direct shear test on plain mild steel bar.				

To perform punching shear test on plain mild steel bar.

To perform tension test on plain mild steel bar.

To perform compression test on wooden cubes when load is applied: Perpendicular to grain and Parallel to the grain.

To determine the oil, water, solids, and clay content of the drilling mud in tension and compression.

To perform Principles of testing machine.

To investigate the surface properties under impact loading.

To determine Hardness of different materials.

To perform the failure criteria experiment on rock samples.

Recommended Books

Andrew pytel, Ferdinand L. Singer, “Strength of Materials” ,4th edition, Harper and Row, 1998.

Robert R. Archer, Stephen H. Crandal, Norman C. Dahi `An Introduction To The “Mechanics Of Solids” Mcgraw-Hill-New York, 1959.

R.C . Hibbeler, “Mechanics Of Materials” 11th Edition, Prentice Hall, 2022.

Course Content

8.24 Fundamentals of Heat & Mass Transfer

CODE & TITLE (PGT-211) **Heat and Mass Transfer**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Foundation)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the basic concepts of heat and mass transfer.	C-2	1
CLO-2	**Apply** the fundamental equations used in heat and mass transfer for petroleum industry.	C-3	2
CLO-3	**Solve** industrial problems related to heat and mass transfer.	C-3	6
Lab Work Learning Outcome			
CLO-1	**Perform** experiments related to heat and mass transfer.	P-5	4
CLO-2	**Comply** to general and experiment specific safety guidelines.	A-2	6
CLO-3	**Report** experimental results with ethical responsibility.	A-2	8

Course Outline

Principles of heat transfer:

Conduction: Fourier's law, one dimensional steady state heat conduction through plane and composite walls, cylinders and spheres with and without heat generating sources,

Convection: Newton's law of cooling, boundary layer, natural (free) and forced convection heat transfer. coefficient of heat transfer for free and forced convection, effects of laminar, transition and turbulent flow on coefficient of heat transfer, flow over flat plates, heat transfer for flow through pipes and ducts,

Radiation: Stefan Boltzmann's law, black body radiation, absorbtivity, reflectivity, transmissivity. Wien's Displacement law, Kirchoff's law, gray body radiation

Principles of mass transfer:

Classification of mass transfer operations; the choice of mass transfer methods; Molecular Diffusion in fluids and solids; Fick's law of Diffusion; Concept of mass transfer coefficients, Equilibrium and diffusion across the

interface and the concept of stages. Phase equilibrium in Mass transfer

Heat and Mass transfer equipment:

Types of Heat exchangers, Types of mass transfer equipment.

Classification, overall heat transfer coefficient. Log Mean Temperature Difference (LMTD) and Number of Transfer Unit (NTU) methods

Lab course outline

Demonstrate the relationship between heat input and surface temperature in free and forced convection

To measure the temperature distribution for steady-state conduction of energy through a uniform plane wall

To observe temperature distribution in fluids undergoing convective heat transfer phenomenon

Influence of heat transfer in counter current and parallel flow conditions in concentric tube heat exchanger.

To investigate fluid to fluid heat transfer in plate heat and shell and tube heat exchanger.

To study mass transfer phenomenon through diffusion

To observe phase separation in distillation columns

Recommended Books

Treybal Robert E. “Mass Transfer Operations”, 1981, McGraw-Hill Book Company.

Kern Donald Q. “Process Heat Transfer”, 1997, McGraw-Hill Book,

Yunus A. Çengel Heat and Mass Transfer: Fundamentals and Applications, McGraw-Hill, 2011

Course Content

8.25 Geophysical survey

CODE & TITLE (PGT-212) **Geophysical survey**		**CREDIT & CONTACT HOURS** (1+1) **48 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Foundation)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Have** a conceptual understanding of geophysical surveys.		C-3	1
CLO-2	**Conduct** appropriate set of geophysical surveys to study a potential subsurface targeted depth.		C-2	3
CLO-3	**Analyze** advantages and limitations of various geophysical methods with respect to geological conditions.		C-4	4
Lab Work Learning Outcome				
CLO-1	**Manage** modern tools for performing geophysical survey and interpretation of data.		P-5	5
CLO-2	**Comply** to general and field safety guidelines.		A-2	7
CLO-3	**Report** survey results with ethical responsibility.		A-2	8
Course Outline				
Basics of Surveying: Definition, Evolution of Surveying, Types and Classes of Surveys, Plane Table Survey, Surveying Instrumentation, Survey References, Units of Measurement, Location Methods, Accuracy and Precision, Errors and Mistakes, Accuracy Ratio, Stationing, Field notes, Field management. This course provides the background for a career in solid-earth, exploration and environmental geophysics. It is split into three sections: (i) seismic methods (ii) electromagnetic methods and (iii) potential field methods (mainly gravity and magnetics). In each section, we start with the underlying mathematical basis and examine applications at global, exploration and environmental scales. The course also involves methods of geophysical data analysis, modelling, visualisation and interpretation through a series of computer laboratories. The course is aimed at students from a range of numerate scientific backgrounds including geoscience, physics, engineering, technology, mathematics and computer sciences.				

Lab course outline
To determine the difference in elevation of two given points Profile levelling of a path To measure horizontal angle at a point by the method of Reiteration and Repetition. To plot a Traverse using deflection angle method. To measure interior angles at each station of closed traverse having “n” sides using the method for measuring angle by repetition method. To observe the distance using the Electronic Distance Metering (EDM) equipment of a base line previously measured over level terrain by an invar or steel tape to determine the systematic errors in the EDM system. Basic operations of Handheld GPS receiver Initialization of Handheld GPS To locate the coordinates of different building around Campus using Handheld GPS.
Recommended Books
William Lowrie, “Fundamentals of Geophysics”, 2nd Edition, 2007 Barry F. Kavanagh, “Surveying: Principles and Applications “, Fifth Edition, Prentice Hall, 2000 A. Ashworth, B. C. Heath,” Advanced Quantity Surveying”, Butterworth- Heinemann - London, 1983.

Course Content

8.26 Technical Drawing and Graphics

CODE & TITLE (PGT-122) **Technical Drawing and Graphics**	**CREDIT & CONTACT HOURS** (1+1) **48 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Foundation)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the basic techniques and symbols of technical drawing.	C-1	1
CLO-2	**Identify,** and explain, technical engineering drawing tools for representing different projections and views.	C-2	2
CLO-3	**Apply** technical drawing principle using computer to develop computer aided graphics.	C-3	5
Lab Work Learning Outcome			
CLO-1	**Practice** technical Drawing Principles to Draw 2-D & 3D Sketches.	P-5	2
CLO-2	**Comply** computer aided drawing for practicing technical drawings.	A-2	4
CLO-3	**Report** technical drawing and graphics by selecting appropriate fonts, symbols, and colors as per professional standards.	A-2	10

Course Outline

Importance of engineering drawing; Drawing techniques, different Symbols used in drawing, types of drawing

Manual drawing instruments and their uses – Drawing board; Minidrafter; Set squares; Drawing instrument box; Scales; Protractor; French curves; Drawing papers; Drawing pencils; Eraser; Drawing pins/clips; Sandpaper block; Duster.

Conventions - ISO and BIS; Layout of drawing sheets; Border lines; Title block; Folding of drawing sheets; Lines, lettering and dimensioning.

Scales – Plane, diagonal and vernier

Curves used in engineering practice:

Orthographic projection – Theory of projection
Lab course outline
Mechanical Drawing: Use of drafting instruments. Basic drafting techniques, drawing and lettering, dimensioning, projections and section of solids, orthographic projections, isometric views with reference to piping and ducting, practice of assembly drawing. Civil drawing: plan, elevations (front, left and right) and details of buildings. Elements of perspective drawings.
Recommended Books
Mitchel & Spencer, "Technical Drawing engineering graphics" , 2011, Peachpit Pr. Dhananjay A Jolhe, Engineering drawing, TMH, 2008 K Venugpoal, Engineering Drawing and Graphics, 3rd edition, New Age International, 1998.

Course Content

8.27 Reservoir Geomechanics

CODE & TITLE (PGT-222) **Reservoir Geomechanics**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Breadth)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** stress states in reservoirs and their changes over the petroleum reservoir.	C-2	1
CLO-2	**Analyze** the stresses and pore pressures using different techniques.	C-4	2
CLO-3	**Apply** geomechanically principles to perform simple calculations related to wellbore stability, and hydraulic fracturing.	C-3	4
Lab Work Learning Outcome			
CLO-1	**Perform** different testing on rock sample and measurement of properties.	P-3	4
CLO-2	**Participate** as an individual and as a group member in the lab related activities.	A-2	9
CLO-3	**Report** summarized experimental data and results.	A-2	10
Course Outline for Theory			

Fundamentals and experimental rock mechanics: Stress and strain analysis, mechanical deformation, strength and failure analysis

Subsurface Stresses: Principal earth stresses: principal and effective, regional and local stresses, overburden stress, horizontal stress orientation, borehole breakouts, drilling-induced tensile fractures, classification of faults, Concept and construction of the Mechanical Earth Model, data requirements and types of input data

Wellbore geo-mechanics and wellbore stability: State of stresses around the wellbore, Modes of rock deformation around the wellbore, Optimization of horizontal well trajectory on the basis of stress regime.

Introduction to reservoir compaction: Geo-mechanical changes in the petro physical properties, Introduction to geo-mechanical modeling
Lab Outlines
Mohr's scale of hardness and identification of its minerals, Core plug fracturing, Uniaxial strain testing, Testing soil and soft rock sample, Triaxial strain testing, Thick-walled cylinder testing, hollow cylinder testing for determining sanding potential, Thermal conductivity, specific heat, and thermal expansion testing, Lab scale Hydraulic fracturing on rock sample
Recommended Books
Mark D. Zoback, "Reservoir Geomechanics" 1st Edition. E. Fjær et al, "Petroleum Related Rock Mechanics", Elsevier 2008 Tarek Ahmed, "Reservoir Engineering Handbook" (Fourth Edition) Elsevier ISBN: 978-1-85617-803-7

Course Content

8.28 Reservoir Fluids

CODE & TITLE (PGT-213) **Reservoir Fluids**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Breadth)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** fluid properties and their impact on reservoir and production technology.	C-2	1
CLO-2	**Evaluate** the dependency of reservoir fluid properties on temperature, pressure, and composition of fluid.	C-5	2
CLO-3	**Calculate** oil field water and fluid properties using different methods and use of equations for predicting the performance of petroleum reservoirs.	C-3	3
Lab Work Learning Outcome			
CLO-1	**Estimate** the permeability using Liquid Permeameter on rock core plugs for OIIP and performance prediction.	P-4	4
CLO-2	**Comply** with general and experiment specific safety guidelines.	A-2	6
CLO-3	**Report** summarized experimental data and results.	A-3	10
Course Outline for Theory			
Chemistry of petroleum and review of thermodynamic concepts **Basic concepts of phase behavior:** single, binary, and multicomponent systems **Equations of State for real fluids** **Phase equilibria calculations for reservoir fluids** **Sampling procedures:** subsurface and surface sampling of reservoir fluids **Determination of reservoir fluid properties:** field data, laboratory analyses, correlations, and equations of state **Application of fluid analysis data for use in reservoir and production engineering calculations**			

Properties of oil field waters **Gas hydrates** **Use of existing/available software for phase behavior calculations**
Lab Outlines
Flash point determination of crude oil, Determination of cloud and pour point of crude oil, Determination of density/specific gravity of crude oil, Determination of kinematic viscosity of crude oil, Determination of percentage of sulphur in crude oil, Determination of surface tension of crude oil, Determination of Gas composition / Liquid Composition using Gas Chromatography, Determination of aniline point, Determination of PVT properties
Recommended Books
William D. McCain, "The Properties of Petroleum Fluids", Second Edition, Petroleum Pub. Co., 1990. Abhijit Y. Dandekar "Petroleum reservoir rock and fluid properties", second edition 2013.

Course Content

8.29 Petroleum Refinery Technology

CODE & TITLE (PGT-22x) **Petroleum Refinery Technology**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Breadth)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** crude oil and natural gas composition for selection of appropriate refining process.	C-4	2
CLO-2	**Compare** and discuss different petroleum refinery processes.	C-4	4
CLO-3	**Describe** the existing petroleum refinery capacity of Pakistan.	C-2	6
Lab Work Learning Outcome			
CLO-1	**Practice** petroleum and petroleum technology theory using experimental tools in Laboratory.	P-3	4
CLO-2	**Comply** to general and field safety guidelines.	A-2	7
CLO-3	**Report** summarized experimental data and results.	A-3	10
Course Outline for Theory			
Crude Oils: Crude Oils Composition, Types of crude oil, Types of Processing for crude oil, Separation and distillation **Petroleum and Fuels:** Petroleum Processing, Separation, Natural gas, composition, stripping at the well head, stripping at the gathering station and Natural gasoline **Products of Primary Distillation:** Separation by vacuum distillation, Indicative yield from primary distillation, separation by absorption, Petroleum Processing conversion processes, cracking and reforming, Products Treatments and Separation of olefins, Polymeric Materials from Petroleum, Inorganic Chemicals from Petroleum, Synthetic Fuels, Synthetic Detergents			

Lab Outlines
Effect of temperature on viscosity by using Viscometer, Determine the Calorific value of given sample of Fuel Determine the Flash Point of different sample, Determine the Aniline Point of the given Sample, Determine the API and Specific gravity of given sample, Determine the color of petroleum product by ASTM colorimeter, Determine the ASTM distillation of petroleum products, Determine the fire point of given sample of fuel using open cup method, Determine Cloud and Pour Point of given Sample
Recommended Books
William A. and Stevens, Donald Gruse, “Chemical Technology of Petroleum”, McGraw-Hill. W. L. Nelson. “Petroleum Refinery Engineering”, McGraw-Hill Lewis F. Hatch and Sami Matar. “Chemistry of Petrochemical Processes”, Gulf Professional Publishing. Hussain Rabia “Fundamentals of Casing Design”, ISBN: 0860108635

Course Content

8.30 Formation Evaluation

CODE & TITLE (PGT-223) **Formation Evaluation**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Breadth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Define** the fundamental petrophysical properties, and factors affecting them.		C-1	1
CLO-2	**Describe** the fundamentals, and basic operational principles of well logging tools.		C-3	2
CLO-3	**Apply** the concept of well logs to determine formation evaluation parameters.		C-3	4
Lab Work Learning Outcome				
CLO-1	**Perform** Interpretation on well Logs to estimate petrophysical and fluid properties.		P-4	4
CLO-2	**Use** derived correlations for basic rock properties measurements.		P-5	3
CLO-3	**Report** summarized experimental data and results.		A-2	10
Course Outline for Theory				
Introduction to porous media **Fundamental properties of fluid permeated rocks:** Porosity, Permeability, Fluid saturations, Wettability, Capillary pressure, Compressibility, Surface kinetics **Core-sampling and preservation** **Introduction to Routine Core Analysis (RCA) and SCAL** **Measurement of basic rock properties** **Interpretation and application of basic core analysis data**				

Special rock properties: Electrical Properties, Mechanical Properties, Acoustic characteristics, Thermal Properties

Use of correlations for the calculation of petrophysical properties with the help of computer.

Introduction to wireline logging and formation evaluation parameters.

Well logging tools: Working principles of Wireline Logging tools, Logging Environment and auxiliary equipment, Log Recording in Tough Logging Conditions, Interpretation of raw logs and computer processed logs

Open Hole Logs: Classification, Data acquisition using Gamma ray log, porosity logs, resistivity logs and magnetic resonance imaging logs etc. to identify the rock and calculate its fluid properties.

Lab Outlines

Determination of the grain density of given core sample, Determination of fluid saturation in the given core sample using modified ASTM Saturation Method, Cleaning the given core sample using ASTM Extraction Methods, Clean the given core sample using Soxhlet Extraction Methods, Determination of the fluid saturation in the given core sample using Retort Oven, Determination of the porosity of the given sample using Gravimetric Method, Determination of the porosity of the given sample using Volumetric Method, Measurement of the porosity of the given sample using Helium Porosimeter, Measurement of the permeability of given core sample using Gas Permeameter, Measurement of the permeability of given core sample using Liquid Permeameter, Interpretation of different resistivity profile, Determination of formation temperature using well log data, Estimation of formation water resistivity using well log data, Determination of corrected resistivities of invaded and uninvaded zones, Estimating the invasion extent using Tornado charts, Determination of shale volume using well log data, Determination of shale corrected porosity of the rock by using sonic log data, Determination of lithology and porosity of the rocks using various cross plots.

Recommended Books

Djebbar Tiab, Erle C. Donaldson, “Petrophysics: Theory and Practice of Measuring Reservoir Rock and Fluid Transport Properties”, 3rd Edition, Elsevier, 2012.

James W. Amyx,” d.Petroleum Reservoir Engineering: Physical Properties”, ISBN: 0070016003.

Bassiouni, Z., “Theory, Measurement, and Interpretation of Well Logs”, SPE Textbook Series Vol. 4, Society of Petroleum Engineers Richardson Texas, 1994.

Rider, M., “The Geological Interpretation of Well Logs”, 2nd Edition, Whittles Publishing, 2000.

George Asquith and Daniel Krygowski, “Basic Well Log Analysis”,ISBN: 0891816674

O. Serra, “Fundamental of Well Log Interpretations:1 The acquisition of Logging data”, ISBN: 044455341X.

Zaki Bassiouni, “Theory, Measurement and Interpretation of Well Logs”,ISBN: 1555630561.

Course Content

8.31 Unconventional Resources

CODE & TITLE (PGT-22x) **Unconventional Resources**		**CREDIT & CONTACT HOURS** (3+0) **48 Theory + 0 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Breadth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the fundamentals and physical reservoir characteristics of unconventional resources.		C-2	1
CLO-2	**Estimate** the fluid flow and its production from unconventional reservoirs.		C-5	4
CLO-3	**Compute** shear, fracturing stresses, and hydraulic fracturing in unconventional formations.		C-3	3
Lab Work Learning Outcome				
CLO-1	**Perform** various characterization methods for the determination of different properties using modern tools.		P-5	5
CLO-2	**Participate** as an individual and as a group member in the lab related activities.		A-2	9
CLO-3	**Report** summarized experimental data and results.		A-2	10
Course Outline for Theory				

Introduction to unconventional resources: Fundamental concept in unconventional resources, Geological characteristics of unconventional Resources, Behavior of unconventional oil reservoirs

Introduction to Coal Bed methane: CBM geological structure and properties, Coal Reserves of Pakistan, CBM conversion and its usage

Introduction to Shale oil and Gas Reservoirs: Development and Formation of shale, Characteristics and Physical properties of tight Shales, Production operations in Shale, Stimulation techniques applied in tight shale, Hydraulic fracturing operation strategies and other operations in shale, Improving oil Recoveries and production optimization in shale.

Fundamental of unconventional Carbonate Reservoirs: Physical characteristics of naturally fractured carbonate Reservoirs, Dual porosity behavior of Carbonate Reservoirs, Permeability features of unconventional tight carbonate Reservoirs, Formation evaluation of unconventional Reservoirs, Production strategy in carbonates, Identification of fractures, types of fractures, Fluid flow behavior in Fractured Carbonate Reservoirs
Lab Outlines
Basic properties, such as porosity, permeability, saturation etc. measurement of shale, Characterization of shale, Characterization of Coalbed Methane, Characterization of unconventional Carbonate Reservoirs
Recommended Books
Unconventional Oil and Gas Resources Handbook Evaluation and Development Edited by Y. Zee Ma Schlumberger, Denver, CO, USA Stephen A. Holditch Texas A&M University, College Station, TX, USA. Usman Ahmed and Nathan Meehan; “Unconventional Oil and Gas Resources, Exploitation and Development”, CRC Press, 2016 Tarek Ahmed, “Reservoir Engineering Handbook” (Fourth Edition) Elsevier ISBN: 978-1-85617-803-7

Course Content

8.32 Corrosion Control Technologies

CODE & TITLE (PGT-312) **Corrosion Control Technologies**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Breadth)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the importance and mechanisms of corrosion.	C-2	1
CLO-2	**Describe** aspects of electrochemistry relevant to corrosion rate measurement.	C-3	2
CLO-3	**Classify** the types of corrosions, and their measurements.	C-4	4
Lab Work Learning Outcome			
CLO-1	**Select** appropriate technique(s) for corrosion prevention.	P-1	3
CLO-2	**Apply** various methods for evaluation of corrosion rates of different materials.	P-5	5
CLO-3	**Report** summarized experimental data and results.	A-2	10
Course Outline for Theory			

Basic Concepts in corrosion: Definition and importance, impact on economy, Electrochemical reactions, Corrosion rate and its determination, Theories of corrosion, Polarization, Passivity, Metallurgical aspects

Forms of Corrosion: Galvanic corrosion, crevice corrosion, pitting, intergranular corrosion, erosion corrosion, flow-accelerated corrosion, stress corrosion cracking, hydrogen induced cracking, microbiologically induced corrosion, underground corrosion, high-temperature corrosion, corrosion fatigue and some case studies

Corrosion Testing: Specimen preparation, exposure tests, open corrosion potential, linear polarization, Tafel slopes, corrosion current, slow-strain-rate tests, AC impedance and Commercial corrosion probes

Prevention and Control of Corrosion: Cathodic protection, Sacrificial anodic protection, Modification of environment, Coatings and inhibitors, Material selection

Lab Outlines
Potential and pH measurements and exposure to equipments used in electrochemical and corrosion studies. Weight loss measurements. Polarization studies determine Tafel slopes, Corrosion current density, Passive current density, Critical current density, Pitting potential. Weldment Corrosion: ASTM A262 practice A and D tests on actual weldments. Stress Corrosion cracking: U-bend tests and SEM. Salt spray tests for organic and metallic coatings and weight loss measurement
Recommended Books
Fontana, M.G., Corrosion Engineering, Tata McGraw-Hill (2008). 3rd ed. Denny A. Jones, Principles and Prevention of Corrosion, 2nd Edition, Pearson-Prentice Hall, 2005. Roberge P R , Corrosion Engineering, McGraw Hill, New York. Uhling H H and Revie R W, Corrosion Control, John Wiley & sons. INC,. Trethewy & Chamberlain, Corrosion for Science and Engineering, Longman Sc& Tech; 2nd revised edition edition, 1996

Course Content

8.33 Sustainable oil & gas Technology

CODE & TITLE (PGT-22x) **Sustainable oil & gas Technology**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Breadth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the basic concepts of sustainable techniques and methods used in oil & gas industry.		C-2	1
CLO-2	**Understand** management techniques of emissions, carbon storage, and capturing used in the industry.		C-4	2
CLO-3	**Recommend** a long-term and environmentally friendly solution for the project.		C-5	7
Lab Work Learning Outcome				
CLO-1	**Conduct** various experimental work and computation related to sustainable oil & gas technology.		P-4	4
CLO-2	**Comply** to field safety regulations and guidelines.		A-2	7
CLO-3	**Report** summarized experimental data and results.		A-2	10
Course Outline for Theory				
Introduction to Sustainability in Oil & Gas Industry **Carbon Capture Methods:** Cryogenic, Membrane Oxyfuel combustion, absorption, Multiphase absorption, adsorption, chemical looping combustion, Calcium looping. **Storage techniques/Methods:** Pre-combustion, Post-combustion, Oxy-Combustion **Monitoring of subsurface storage:** Volumetric storage of an oilfield storage site, Leakage Remediation Greenhouse Gases: Types of greenhouse gases, mitigation the effect of greenhouse gases **Flaring system implication:** Basic concept of flaring, efficient use of flared gases				

Oil field water: Treatment or conditioning of produced water, reuse of produced as a driving mechanism, water flood mechanisms

Reservoir characterization and phase behavior

CO_2 Flooding: Compression and Transport of Carbon Dioxide, CO2 injection, understanding of injections' parameter, Miscibility, CO_2 gas mechanism, Minimum Miscibility Pressure (MMP), Reservoir Implication,

Land Resources and Conservation: Introduction to land resources, Conservation methods

Lab Outlines

Determination of CO_2 Physical and chemical properties, Selection of appropriate reservoir storage type, Calculation of suitable reservoir types for carbon storage, injectivity calculation, depth calculation, Calculation of realistic storage volume of an oilfield storage site, Conditioning and treatment Oil field water, Reservoir characterization

Recommended Books

David Thomas, Sally Benson "Carbon Dioxide Capture for Storage in Deep Geologic Formations - Results from the COÂ² Capture Project" Vol 1 - Capture and Separation of Carbon Dioxide ... and Verification (Co2 Capture Project)

M.Mercedes, Maroto-Valer "Developments and Innovation in Carbon Dioxide (CO2) Capture and Storage Technology" Volume 2: Carbon Dioxide (CO2) Storage and Utilisation (Woodhead Publishing Series in Energy)

Tarek Ahmed, "Reservoir Engineering Handbook" (Fourth Edition) Elsevier ISBN: 978-1-85617-803-7

Course Content

8.34 Offshore Technology

CODE & TITLE (PGT-31x) **Offshore Technology**		CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Petroleum & Gas Engineering Technology (Breadth)**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** basic concepts of offshore technology, its types, and methods.	C-2	1
CLO-2	**Apply** the concepts of offshore technology under different marine environments.	C-3	4
CLO-3	**Analyze** practical challenges in flow assurance, subsea processing, well-drilling, marine operations the industry is facing today.	C-4	6

Course Outline for Theory

Introduction to offshore technology: overview of standards and rules in subsea development

Major Elements of Offshore Production Systems: Wells (subsea/platform), Well platforms/well servicing rigs, Feeder subsea pipelines, Processing platforms, Export pipelines for oil/gas, Tankers for oil evacuation,

Types of Offshore Activities: Seismic surveying, Exploration, Production, well drilling , Depressurization and separation, Transportation, Supply, Maintenance and repair, Watchkeeping

Unconventional Drilling Methods: Fishhook, Lateral, Upside down, Fracking

Types of Offshore Platforms: Fixed platform, Compliant tower, Jack-up platform, Concrete gravity base structure, Tension leg platform, Semi-submersible vessel, Floating production system, Spar platform, Subsea system

Facilities of Offshore Platforms: Wellhead platform, Process platform, Platform complex

Components of Offshore Detection Systems: Gas detection, Fusible plug, Fire detection, Smoke detection, Heat detection

Components of Offshore Suppression Systems: Firewater pump, Water sprinkler, Dry chemical, CO2 exchanger, AFFF system

Components of Processing Systems: Separation, Gas dehydration, treatment, conditioning, Gas compression and metering, Gas metering, Oil dehydration, stabilization, desalting, Oil pumping and metering

Recommended Books
D.A. Fee “Technology for Developing Marginal Offshore Oilfields”
Peter Brudenall “Technology and Offshore Outsourcing Strategies”
O. Faltinsen “Sea Loads on Ships and Offshore Structures (Cambridge Ocean Technology Series)”
Mark J Kaiser, Brian F Snyder “Offshore Wind Energy Cost Modeling: Installation and Decommissioning [1 ed.]”

Course Content

8.35 Well Stimulation Techniques

CODE & TITLE (PGT-31x) **Well Stimulation Techniques**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Breadth)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the fundamental concepts related to formation damage, and its types.	C-1	1
CLO-2	**Understand** the causes and effects of formation damage during field appraisal and development.	C-2	2
CLO-3	**Implement** the stimulation techniques in production systems.	C-3	4
Lab Work Learning Outcome			
CLO-1	**Conduct** different stimulation techniques using various modern tools.	P-4	5
CLO-2	**Participate** as an individual and as a group member in the lab related activities.	A-2	9
CLO-3	**Report** summarized experimental data and results.	A-2	10

Course Outline for Theory

Introduction to Formation Damage: Fundamental to Formation Damage, Causes of Formation Damage, Effect of Formation Damage on Well's Productivity Index, Formation Damage Indicator and Consequences

Introduction to Stimulation Concepts and Objectives: Production System Introduction, Flow Rate and Permeability Equation, Effect of a Near Wellbore Damaged Zone on Well Inflow Pressure Profile, Basic of well stimulation, Stimulation Important Parameters, Types of Well Stimulation

Types of Acid and Acid Formulations: Selection of Candidates for Stimulation, Matrix Fluid Selection, Types of Acid and Selection, Matrix Acidizing, Carbonate Acidizing, Chemical Stimulation without Acid, Sandstone Acidizing, Factors Affecting Reaction Rates

Basic of Hydraulic Fracturing, equipment, fluid properties, and operation: Introduction into Hydraulic Fracture, Hydraulic fracturing equipment, Hydraulic Fracture Fluids and Chemicals, Proppant, Hydraulic Fracture Operation **Coil tubing operations, post-frac events and their monitoring**
Lab outlines
Determination of productivity ratio of a reservoir stimulation job, Determination of skin factor, Well hydraulics calculations for an anticipated stimulation job, Hydraulic fracture and its modelling using application software, Acid solubility test, Acid fracturing job and its modelling using application software, Damage zone permeability using Darcy's equation, Using diversion methods while during acidizing job
Recommended Books
Economides, M. J.; Nolte, K. G. Reservoir Stimulation, Third.; John Wiley & Sons Ltd, 2000. Aminzadeh, F. Hydraulic Fracturing and Well Stimulation; Scrivener, 2019. Robert S. Schechter. Oil Well Stimulation; Prentice-Hall, Inc., 1992.

Course Content

8.36 Artificial Lift System

CODE & TITLE (PGT-31x) **Artificial Lift System**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Breadth)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Classify** different artificial lift methods for specific field conditions.	C-4	1
CLO-2	**Analyze** solutions for given problems using artificial techniques.	C-4	2
CLO-3	**Investigate** the key parameters used in artificial gas lift installation.	C-5	4
Lab Work Learning Outcome			
CLO-4	**Calculate** inflow performance and outflow performance using different mathematical relation.	P-4	2
CLO-2	**Comply** to field safety regulations and guidelines.	A-2	7
CLO-5	**Report** summarized experimental data and results.	A-3	10

Course Outline for Theory

Reservoir Performance: Inflow and Outflow Relationships: Reservoir performance: wellbore and reservoir performance overview, Pressure loss in the wellbore, Well productivity, Concepts of productivity index, Inflow and outflow relationships, Formation damage

Why and When do We Need Artificial Lift: Well production problems: asphaltenes, waxes, hydrates, inorganic, scale formation, corrosion, Formation damage causes and prevention techniques, Impact of changing well conditions and need for artificial lift, Overview of artificial lift technology: sucker road pump application, hydraulic pump application, jet pump, gas lift, Electrical Submersible Pump (ESP), Application of artificial lift technology and its limitations, Artificial lift screening methods

Sucker Rod Pumping and Gas Lift System: Concept, limitations and advantages of the sucker rod pumping system, components of the sucker rod pump, Troubleshooting of the sucker rod pump systems, Concept and types of the gas lift system, components of the gas lift system, Limitation and advantages of the gas lift system

ESP System: Concept, equipment and accessories of the ESP system, ESP application: pump performance curves, pump intake curves, typical problems, installation, troubleshooting, best practices for installation and maintenance, Steps to correctly size an electric submersible pump (ESP) system. basic sizing principles for the pump, motor and cable, Importance of correctly matching well productivity to pump performance, Use of data to diagnose well/equipment problems, Limitation and advantages of the ESP system

Hydraulic and Jet Pumping / Progressing Cavity Pumping Systems: Concept, limitation and advantages of the hydraulic pumps, Concept, limitation and advantages of the jet pumping, Concept, limitation and advantages of the Positive Cavity Pump (PCP) pumps, Operating conditions of the hydraulic, jet and PCP pumps, best practices for installation and maintenance of the artificial lift techniques, Criteria for selection of artificial lift systems and artificial lift screening methods

Lab Outlines

Establishing different inflow performance relationships, Determination of vertical lift performance of a well using choke and bottom-hole parameters, Determination of reservoir/bottom-hole parameters using surface production data, Interpretation of Production Logging Tool data for well diagnostics, Determination of productivity ratio of a reservoir stimulation job, Well hydraulics calculations for an anticipated stimulation job, Complete hydraulic fracture application and its modeling, Complete acid fracturing job and its modeling, Graphical determination of the point of gas injection for a gas lift application, Universal valve spacing application for a gas lift installation

Recommended Books

Petroleum Production Systems by Michael J. Economides, A. Daniel Hill

The Technology of Artificial Lift Methods vol 1, by Kermit E. Brown, Pennwell Corp

Production Operations, by Thomas O. Allen and Alan P. Roberts,.

Principles of Oil Well Production by T. E. W Nind

Natural Gas Production Engineering by Chi U. Ikoku

Well Performance by Michael Golan and Curtis Whitson

Surface Operation in Petroleum Production, by G. V. Chillingarian, J. O. Robertson

Course Content

8.37 Non-destructive Testing

CODE & TITLE (PGT-31x) **Non-destructive Testing**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Breadth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the basic knowledge of Non-Destructive Testing.		C-1	1
CLO-2	**Compare** different Non-Destructive Testing techniques.		C-4	2
CLO-3	**Apply** various Non-Destructive Testing methods in petroleum industry.		C-3	3
Lab Work Learning Outcome				
CLO-1	**Investigate** a system or its part using different Non-Destructing Testing.		P-4	4
CLO-2	**Participate** as an individual and as a group member in the lab related activities.		A-2	9
CLO-3	**Report** experimental data and results and recommend appropriate non-destructive testing method.		A-2	10
Course Outline for Theory				
Introduction to Non-Destructive Testing (NDT), Application of Non-Destructive Testing, Testing Methods: Visual NDT (VT), Ultrasonic NDT (UT), Radiography NDT (RT), Eddy Current NDT (ET), Magnetic Particle NDT (MT), Acoustic Emission NDT (AE), Dye Penetrant NDT (PT), Leak Testing (LT), Application and Benefits of the use of the Above-mentioned techniques				

Lab Outlines
Inspection of welding job using different Non-Destructive Testing, Inspection of vessel's Leak, Inspection of various equipment using Visual Testing, Ultrasonic Testing, Radiography Testing, Eddy Current (Electromagnetic) Testing, Magnetic Particle Inspection, Acoustic Emission Testing, Dye Penetration Testing, Leak Testing.
Recommended Books
Hull, B.; John, V. Non-Destructive Testing, first.; MACMILLAN EDUCATION LTD: London, 1988. Barkanov, E. N.; Dumitrescu, A. Non-Destructive Testing and Repair of Pipelines; Parinov, I. A., Ed.; Springer, 2018. Hallai, C. (Carlos); Kulcsar, P. (Pablo). Non-Destructive Testing 92. In 13th World Conference on Non-Destructive Testing; Elsevier, 1992; Vol. I

Course Content

8.38 Drilling Engineering Technology

COURSE CODE & TITLE (PGT-224) **Drilling Engineering Technology**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** fundamental concepts of drilling engineering, and various components of a rotary drilling rig.		C-2	2
CLO-2	**Analyze** the drilling problems and pressure requirements at every stage of the drilling operation, based on rheological models and drilling hydraulics.		C-4	3
CLO-3	**Evaluate** challenges associated with downhole drilling operations.		C-5	12
Lab Work Learning Outcome				
CLO-1	**Perform** experiments to evaluate the drilling mud properties.		P-3	4
CLO-2	**Participate** actively as an individual and as a group member in the lab related activities.		A-2	9
CLO-3	**Comply** with well-drilling rig safety regulations and guidelines.		A-2	7
Course Outline for Theory				
Rotary drilling operations: Working principles of various components of Rig systems: Introduction to different models of RIG components, Mud Pumps, types and horsepower requirements, Drill Lines, and Ton Miles calculations. Drill Bit types and selection. Casing installation, cementing, rotary drilling, rotary steerable systems, Mudflow lines, mitigation of wellbore failure, pore, and formation pressure concept, mud density using Mud Balance, the viscosity of mud using Marsh Funnel, apparent, viscosity using Rotational Viscometer, clay/sand contents of drilling mud using Sieve Analysis, Pressure relationship in the formation and borehole. MPD and UBD concept. Total system pressure drops. Bottom Hole assembly concept for vertical wells. Drill Pipe, Heavy Weight Drill Pipe, Drill Collar, Stabilizer, Bit Sub, Roller Cone Bit, Draw Works, Top Drive Unit System, Fluid Circulation System, Drillers cabin, Directional Drilling				

Lab Outlines
Determination of mud density using Mud Balance, the viscosity of mud using Marsh Funnel, apparent, viscosity using Rotational Viscometer, clay/sand contents of drilling mud using Sieve Analysis; Demonstration on different models of RIG components, Drill Pipe, Heavy Weight Drill Pipe, Drill Collar, Stabilizer, Bit Sub, Roller Cone Bit, Draw Works, Top Drive Unit System, Fluid Circulation System, Drillers cabin.
Recommended Books
A. T Bourgoyne jr., K. K. Millehim, “Applied Drilling Engineering”, ISBN: 1555630014. J. L. Lummus, “Drilling Fluids Optimization: A Practical Field Approach”, ISBN: 0878143068. Hussain Rabia, “Oil Well Drilling Engineering, Principles and Practice”, ISBN: 0860107140. Hussain Rabia “Fundamentals of Casing Design”, ISBN: 0860108635 Steve Devereux, “Drilling Technology in Nontechnical Language”, Pennwell Publishing; 1999. Halliburton cementing, casing, and cement data tables prepared by Halliburton Company.

Course Content

8.39 Reservoir Engineering Technology

COURSE CODE & TITLE (PGT-311) **Reservoir Engineering Technology**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the concept of reservoirs, geometry and flow systems, pressure diffusion, frontal advancement, water, and gas coning, figuring out its predictions, and suggest remedial treatments.		C-3	1
CLO-2	**Apply** different flow equations for different geometry and flow systems such as frontal advance, average permeability, and pressure.		C-4	3
CLO-3	**Evaluate** the hydrocarbon recoveries from reservoirs under different derive mechanisms.		C-5	12
Lab Work Learning Outcome				
CLO-1	**Operate** the concerned tools and computational applications to achieve outcomes of flow equations.		P-4	4
CLO-2	**Utilize** the relevant software for analysis, estimations of oil reserves, and water influx from the oil well.		P-5	5
CLO-3	**Report** summarized experimental data and results.		A-2	10
Course Outline for Theory				
Fundamentals of reservoir engineering: Classification of reservoir fluid flow systems, Darcy's law for fluid flow through porous media, Different forms of Darcy's law, Steady state and unsteady state flow. Basic flow equations: Continuity equation and its derivation, Diffusivity equation and its different forms, Pressure distribution and pressure gradient for linear, radial, compressible, slightly compressible, and incompressible steady state and unsteady state flow conditions, Average permeability calculations for beds in series and beds in parallel for linear and radial reservoir geometry.				

Lab Outlines
Demonstration on lab safety measures, oil composition, Oil formation volume factor, gas expansion factor, reservoir fluid density, gas gravity, gas gradient, viscosity by different correlations, reservoir gas isothermal compressibility correlations, gas compressibility factor through various correlations, reserves estimation by volumetric method, reserves estimation by Material Balance method, reserves estimation by software Approach, Water/gas Coning and fingering, phase behavior of gas reservoirs.
Recommended Books
Mark P. Walsh and Larry W. Lake, “A Generalized Approach to Primary Hydrocarbon Recovery”, Volume 4, Elsevier, 2003. Tarek Ahmed, “Reservoir Engineering Handbook”, Third Edition, Elsevier, 2006. Brian F. Towle, “Fundamental Principles of Reservoir Engineering”

Course Content

8.40 Petroleum Production Technology

COURSE CODE & TITLE (PGT-321) **Petroleum Production Technology**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the basic components, issues, and techniques used to produce hydrocarbons.		C-2	1
CLO-2	**Analyze** choke performance, well performance through IPR, TPR, and using different software.		C-4	5
CLO-3	**Evaluate** the challenges encountered in surface production flow performance from different reservoirs.		C-5	12
Lab Work Learning Outcome				
CLO-1	**Operate** production forecasts using different tools and software.		P-3	4
CLO-2	**Plot and interpret** the graphs used for oil and gas flow in the wellbore.		P-4	5
CLO-3	**Report** summarized experimental data and results.		A-2	10
Course Outline for Theory				
Introduction to Petroleum Production system: Components and working principles. Well completion, tubing, and packer installation, smart completion, mechanism and functions of choke, different inflow performance relationships, vertical lift performance of a well-using choke and bottom hole parameters IPR for different types of reservoirs: Inflow Performance Relationship (IPR) models, Straight line and curve IPR, Time dependency of the IPR models, Vertical lift performance (VLP) 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. swabbing operations, wireline operations, mechanism of sand exclusion by chemical consolidation technique				

Lab Outlines
Demonstration on the function of tubing annulus communication, circulating devices, functions of flow coupling, blast joint and landing nipple, working principle of permanent and retrievable packers, functions of cross over, pup joint and perforated pipe, mechanism and function of perforation techniques, mechanism and functions of choke, different inflow performance relationships, vertical lift performance of a well using choke and bottom hole parameters, different software for production system analysis including nodal analysis, Sensitivity analysis for optimization of well completion components of by software approach, well intervention/work over operations, swabbing operations, wireline operations, mechanism of sand exclusion by chemical consolidation technique, mechanism of mechanical sand exclusion methods
Recommended Books
John Lee, “Well Testing”, Volume 1, SPE Textbook Series, 1982. G.Bourdet, “Well Testing: Interpretation methods”, IFP, 1998 M. A. Sabet, “Well Test Analysis” Robert C. EarlougherJr , “Advances in Well Test Analysis”, ISBN: 0895202042.

Course Content

8.41 Well Testing

COURSE CODE & TITLE (PGT-313) **Well Testing**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the testing processes and mechanisms of transient and deliverability tests.		C-2	1
CLO-2	**Apply** various techniques of pressure transient, well deliverability testing, and well test data for determination of reservoir and well bore properties.		C-4	3
CLO-3	**Evaluate** the pseudo pressures in gas well deliverability testing.		C-5	4
Lab Work Learning Outcome				
CLO-1	**Adapt** well-testing data to plot the test outcome and interpret the well-test data.		P-3	4
CLO-2	**Apply** relevant software for well-test analysis and estimations.		P-4	5
CLO-3	**Participate** as an individual and as a group member in the lab related activities.		A-2	9
Course Outline for Theory				
Introduction to pressure transient tests: Draw-down and build-up test analysis, well test analysis by use of type curves and derivative curves, Analysis of pressure buildup tests distorted by phase redistribution, Well test interpretation in hydraulically fractured wells, Interpretation of well test data in naturally fractured reservoirs. Gas Well Testing: Deliverability testing of gas wells, Fundamental equations in deliverability testing, flow after flow test, isochronal test and modified isochronal test, Use of pseudo pressure in deliverability testing and real gas pseudo pressure analysis, Guidelines for gas well testing.				

Lab Outlines
Demonstration of safety considerations during all aspects of well-testing processes. Demonstration on Pressure Builds up test analysis. Demonstration on Superposition Theorem & forms of Superposition Theorem. Demonstration of Pressure Drawdown test. Understanding of the Type Curves used in the Petroleum industry. Demonstration on Interference testing. Demonstration on Pulse testing. Demonstration on Gas Well deliverability testing. Demonstration on Flow after Flow test. Demonstration on Isochronal test.
Recommended Books
John Lee, “Well Testing”, Volume 1, SPE Textbook Series, 1982. G.Bourdet, “Well Testing: Interpretation methods”, IFP, 1998 M. A. Sabet, “Well Test Analysis” Robert C. EarlougherJr, “Advances in Well Test Analysis”, ISBN: 0895202042.

Course Content

8.42 Principles of Enhanced Oil Recovery

COURSE CODE & TITLE (PGT-412) **Principles of Enhanced Oil Recovery**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Select** the appropriate enhanced oil recovery techniques for secondary and tertiary recovery.		C-4	2
CLO-2	**Apply** enhanced oil recovery processes with screening criteria for thermal recovery methods, miscible flooding, and chemical injection.		C-4	3
CLO-3	**Evaluate** the challenges associated with the selection criteria of enhanced oil recovery techniques.		C-5	12
Lab Work Learning Outcome				
CLO-1	**Operate** the lab tools for estimation of reservoir properties for proper screening of flooding technique.		P-4	4
CLO-2	**Conduct** experiments to evaluate the feasibility of the proposed flooding project.		P-4	5
CLO-3	**Participate** as an individual and as a group member in the lab related activities.		A-2	9
Course Outline for Theory				
Introduction and Overview of EOR methods and EOR status worldwide. Basic petrophysical properties; Permeability/porosity, Relative permeability, capillary pressure, and residual oil saturation.Mobility ratios, displacement efficiency, sweep efficiency, factors to consider in water flooding, the optimum time to water flood, performance predictions using fractional flow and frontal advance equations, and water sources. Secondary and tertiary recovery techniques. Thermal Recovery Methods: Steam and hot water displacement, In-situ combustion. Miscible Flooding: Thermodynamic miscibility, ternary diagram, first and multiple contact miscibilities, Carbon dioxide, nitrogen, and water alternating gas flooding. Chemical injection: Polymers, micellar polymer, alkaline, and surfactants.				

Lab Outlines
Demonstration of water injection process for improving oil recovery from the depleted oil reservoir. Determine major factors involved in preparing the field pilot project for the water injection process. Demonstration on high-pressure gas injection for depleted oil reservoir. Laboratory investigation for understanding the in-situ combustion processes for heavy oil reservoirs. Demonstration of steam stimulation process for the heavy oil recovery process. demonstration on stream flooding process for heavy oil reservoir. Laboratory investigation for understanding air injection process for light oil reservoir. Demonstration on CO2 flooding process for improving oil recovery from the depleted oil reservoir. Demonstration on nitrogen flooding for depleted oil reservoirs. Demonstration of polymer flooding process for improving oil recovery. Demonstration on surfactant and micellar polymer flooding process Demonstration on alkaline flooding or caustic flooding process.
Recommended Books
Don W. Green and G. Paul Willhite, “Enhanced Oil Recovery”, 22nd Edition, Volume 6, Society of Petroleum Engineers Richardson Texas, 1998. Larry W. Lake, “Enhanced Oil Recovery”, Society of Petroleum Engineers Richardson Texas, 2010. Marcel Latil, “Enhanced Oil Recovery” ISBN: 0872017753. Rafael Sandrea, Ralph Nielsen, “Dynamics of Petroleum Reservoirs under Gas Injection”, ISBN: 0872012190.

Course Content

8.43 Gas Reservoir Engineering

COURSE CODE & TITLE (PGT-41x) **Gas Reservoir Engineering**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the basic terminologies used in gas reservoir engineering technology.		C-2	1
CLO-2	**Apply** volumetric and material balance methods for recoveries from a gas reservoir.		C-3	3
CLO-3	**Assess** the processes and properties related to the gas condensate reservoir.		C-5	4
Lab Work Learning Outcome				
CLO-1	**Operate** the relevant tools and apply computational methods to identify the recoverable gas volume from subsurface.		P-3	4
CLO-2	**Conduct** different techniques to estimate the gas volume in each reservoir.		P-4	5
CLO-3	**Participate** actively as an individual and as a group member in the lab related activities.		A-2	9
Course Outline for Theory				
Water/gas Coning and fingering and prediction by different methods for different reservoirs (Homogeneous, Isotropic, and Fractured), Remedial treatments for coning and fingering. Gas Condensate Reservoirs: Reservoir types defined concerning phase diagrams, Calculation of original gas and condensate in place for volumetric reservoirs, Reserves calculations with and without compositional data, Well Testing and sampling, material balance and performance of volumetric retrograde gas condensate reservoirs.				

Lab Outlines
Demonstration of gas engineering lab safety measures. Determination of gas composition by gas chromatography. Determination of reservoir gas formation volume factor and gas expansion factor. Determination of reservoir gas density, gas gravity, and gas gradient. Determination of reservoir gas viscosity by different correlations. Determination of reservoir gas isothermal compressibility correlations. Determination of gas compressibility factor through various correlations. Gas reserves estimation by volumetric method. Gas reserves estimation by Material Balance method. Gas reserves estimation by software Approach.
Recommended Books
Chi U. Ikoku, “Natural Gas Production Engineering”, ISBN: 0894646397. Dale Beggs, “Gas Production Operations”, ASIN: B001O78FVY. David A. T. Donohue, “Gas Well testing: theory, practice and regulation”, ISBN: 9780934634106 Amanat Chaudhry, “Oil Well Testing Handbook”, ISBN: 0750677066. W. John Lee, “Gas Reservoir Engineering”, ISBN: 1555630731.

Course Content

8.44 Surface Petroleum Operations

COURSE CODE & TITLE (PGT-415) **Surface Petroleum Operations**		**CREDIT & CONTACT HOURS** (2+2) **32 Theory + 96 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** the problems encountered in equipment and installed components at surface for any oil and gas field.		C-4	2
CLO-2	**Apply** the appropriate process relating to surface petroleum operations.		C-3	3
CLO-3	**Evaluate** challenges associated with surface petroleum operations in field.		C-5	12
Lab Work Learning Outcome				
CLO-1	**Operate** Surface Petroleum Operations using different tools and software.		P-3	5
CLO-2	**Conduct** experimental work and computation related to Surface Petroleum Operations.		P-4	4
CLO-3	**Comply** to field safety regulations and guidelines.		A-2	7
Course Outline for Theory				
Manifold and Gathering Systems: Production manifolds, Flow line characteristics, Gathering systems, Flow of fluids in pipes, Pigging, Separation, Oil treatment or Water treatment, Gas Treatment, Pumps, and Compressors, Gas treatment, Pumps, Compressors, Storage tanks, gun barrels, pressure/vacuum relief, flame arrestors, Stabilizers, Foams, emulsions, paraffin, asphaltenes, hydrates, salt removal, Dehydrators. Properties of fluids at the surface, Flowlines, piping, gathering systems; solids and liquid limits, Oil - water- gas - solids – contaminants, Separation and treatment, 2-3 phase separators, free water knockouts, centrifugal, filter, Storage tanks, gun barrels, pressure/vacuum relief, flame arrestors, Stabilizers, Foams, emulsions, paraffin, asphaltenes, hydrates, salts, Dehydrators, Water treaters: SP packs, plate interceptors, gas floatation, coalescers, hydro cyclones, membranes, Acid gas treatment: coatings, closed system, chemicals, solvents, conversion; stress cracking, Valves: all				

types; regulators, Pumps/Compressors: centrifugal, positive displacement, rotary, reciprocating, ejectors, Metering: orifice, head, and turbine

Lab Outlines

Demonstration of surface facilities engineering lab safety measures.

Demonstration of wellhead and its components.

Demonstration of separation mechanism and separators.

Demonstration on choke manifold and gathering point.

Demonstration of fixed and adjustable chokes.

Demonstration of flange connections and pipe assembly joints.

Demonstration of different types of threaded connections.

Demonstration on oil treatment plants.

Demonstration of distillation and gas treatment towers.

Demonstration on desalination and desilting units and their mechanism.

Recommended Books

Srinivasan, C., 1991. Surface operations in petroleum production, II: by George V. Chilingarian, John O. Robertson and Sanjay Kumar, 1989. Elsevier, Amsterdam, 562 pp., US $166.00, ISBN 0-444-42677-9.

Abdel-Aal, H.K., Aggour, M.A. and Fahim, M.A., 2003. Petroleum and gas field processing. CRC Press...

George V. Chilingar, Carrol M. Beeson. Surface Operations in Petroleum Production. American Elsevier, 1969

Ken Arnold and Maurice Stewart. Surface Production Operations, Design of Gas-Handling Systems and Facilities, Volume 1, Third Edition • 2008.

Course Content-

8.45 Oil Field Chemistry

COURSE CODE & TITLE (PGT-411) **Oil Field Chemistry**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain s**ubsurface water chemistry, chemical injection, and processing chemicals.	C-2	1
CLO-2	**Apply** the appropriate process associated with oil field chemistry.	C-4	4
CLO-3	**Calculate** the properties of oil field water.	C-5	5
Lab Work Learning Outcome			
CLO-1	**Operate** Oil Field Chemicals using different tools and equipment.	P-3	5
CLO-2	**Conduct** various experimental work and computations related to Oil Field Chemistry.	P-4	4
CLO-3	**Report** summarized experimental data and results.	A-2	10

Course Outline for Theory

Subsurface water chemistry, Oil field water, petroleum-associated water, connate water, interstitial water, water and gas shut-off, chemical sand control, liquid unloading of wells, asphaltene and scale control (including squeeze treatments, downhole injection, etc.) Water injection chemicals - biocides, oxygen scavengers, desulfation, tracers, water-based drag reducers, IOR chemicals

Production well and stimulation methods - acidizing and scale removal, Flow assurance issues - corrosion, microbiological problems, H2S scavenging, wax/paraffin, gas hydrates, scaling, naphthenates. Integration with reservoir management, HPHT, subsea tiebacks, chemical injection, and wintering. Processing chemicals - demulsifiers, flocculants, defoamers

Lab Outlines
Demonstration on Subsurface water chemistry, Oil field water, petroleum-associated water, connate water, and interstitial water. Demonstration on water and gas shut-off treatment and mechanism. Demonstration on chemical sand control by chemical additives. Demonstration on liquid unloading of wells, asphaltene, and scale control treatments Demonstration on surfactant preparation for improved oil recovery. Demonstration on polymer preparation for improved oil recovery. Demonstration of alkaline and saline injection fluid preparation for improved oil recovery Demonstration on the preparation of oil-based mud Demonstration on the preparation of water-based mud Demonstration on emulsions and crosslinkers used at oil and gas fields
Recommended Books
Caili Dai, Fulin Zhao. Oilfield Chemistry. Springer Nature Singapore Pte Ltd. and China University of Petroleum Press 2018. Johannes Fink. Petroleum Engineer's Guide to Oil Field Chemicals and Fluids. 1st Edition - May 13, 2011. Henry A. Craddock. Oilfield Chemistry and its Environmental Impact. John Wiley & Sons Ltd, 2018

Course Content

8.46 Well Control Techniques

COURSE CODE & TITLE (PGT-414) **Well Control Techniques**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the fundamental concepts of well control techniques, and various components of controlling well flow during drilling.	C-2	2
CLO-2	**Identify** well control problems, and determine pressure requirement along with blow-out prevention.	C-4	3
CLO-3	**Classify** challenges associated with the selection criteria of well-control techniques.	C-5	12
Lab Work Learning Outcome			
CLO-1	**Operate** the lab equipment that are used to estimate the well control and kill sheets	P-3	5
CLO-2	**Conduct** the experiments on drilling mud to prepare high-density muds to control formation kick or blow out	P-4	4
CLO-3	**Comply** with drilling rig safety regulations and guidelines	A-2	7
Course Outline for Theory			
BOP equipment, well control equipment, Formation, and fracture pressures Leak off tests, Kick tolerance and Maximum Allowable Annulus Surface Pressure) MAASP, Gas expansion and casing seat selection Formation and fracture pressures, Leak off tests, Kick tolerance and MAASP, Gas expansion and casing seat selection. Blow-out prevention: Primary and Secondary Well Control, Well Shut-in policies: details of Well Control Methods. Kill Sheet: Vertical and deviated wells, Well Control Equipment. International well control federation regulations, the international association for drilling contractors standards for drilling stable wells.			

Lab Outlines
Demonstration on well control mechanism. Demonstration on formation pore pressure, fracture pressure and mud pressure. Demonstration on formation leak-off test. Demonstration on kick tolerance Demonstration on mud circulation. Demonstration of maximum allowable annulus surface pressure. Demonstration on kill sheet Demonstration on well control in deviated wells Demonstration on well control in horizontal wells Demonstration on blow-out prevention equipment and mechanism
Recommended Books
Jr. Adam T. Bourgoyne, Keith K. Millheim, Martin E. Chenevert and Jr. F. S. Young, “Applied Drilling Engineering”, Volume 2, Society of Petroleum Engineers Richardson Texas, 1986. Steve Devereux, “Drilling Technology in Nontechnical Language”, Pennwell Publishing, 1999. A. T Bourgoyne jr., K. K. Millehim, “Applied Drilling Engineering”, ISBN: 1555630014. J. L. Lummus, “Drilling Fluids Optimization: A Practical Field Approach”, ISBN: 0878143068. Hussain Rabia, “Oil Well Drilling Engineering, Principles and Practice”, ISBN: 0860107140

Course Content

8.47 Drilling Fluid Hydraulics

COURSE CODE & TITLE (PGT-41x) **Drilling Fluid hydraulics**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the fundamental concepts of drilling fluid hydraulics and various components of surface pumps.	C-2	2
CLO-2	**Solve** the problem related to drilling fluid hydraulics.	C-3	3
CLO-3	**Evaluate** the challenges associated with drilling strings during drilling operations.	C-5	12
Lab Work Learning Outcome			
CLO-1	**Operate** the lab equipment that are used to estimate the drilling mud flow in the wellbore.	P-3	4
CLO-2	**Conduct** experiments on pumps to analyze them for a particular section of the wellbore.	P-4	5
CLO-3	**Comply** with drilling rig safety regulations and guidelines.	A-2	7
Course Outline for Theory			
Wellbore hydraulics Design of circulation system, hydrostatic pressure in gas and liquid columns. Hydrostatic pressure in complex fluid columns. Annular pressure during well control operations. Non-static well conditions. Rheological Model (Newtonian and Non- Newtonian model). Mud hydraulics. Blow-out prevention: Primary and Secondary Well Control, Well Shut-in policies: details of Well Control Methods. Control subsurface pressures, Provide a buoyant effect to the drill string and casing, Minimize hole erosion due to the mud's washing action during movement, Remove cuttings from the well, clean the bit, and remove cuttings from below the bit, Increase penetration rate, Size surface equipment such as pumps, Control surge pressures created by lowering pipe into the well, Minimize wellbore pressure reductions from swabbing when pulling pipe from the well, Evaluate pressure increases in the wellbore when circulating the mud, Maintain control of the well during kicks			

Lab Outlines
Determination of control subsurface pressures Demonstration of Provision flow regimes through drill string and casing Demonstration on Minimize hole erosion due to the mud's washing action during movement Demonstration on Remove cuttings from the well, clean the bit and remove cuttings from below the bit Demonstration on drilling rate, Increase penetration rate, and weight on bit Demonstration on Size surface equipment such as pumps and agitators Determination of Control surge pressures created by lowering the pipe into the well Demonstration on Minimize wellbore pressure reductions from swabbing when pulling pipe from the well Determination of pressure increases in the wellbore when circulating the mud. Demonstration on drilling hydraulics and control of the well during kicks
Recommended Books
Aird, P., 2018. Deepwater drilling: well planning, design, engineering, operations, and technology application. Gulf Professional Publishing. Skinner, Les. Hydraulic rig technology and operations. Gulf Professional Publishing, 2018. Ramsey, Mark S. Practical wellbore hydraulics and hole cleaning: unlock faster, more efficient, and trouble-free drilling operations. Gulf Professional Publishing, 2019. Crumpton, Howard. Well-control for completions and interventions. Gulf Professional Publishing, 2018. Grace, Robert D. Blowout, and well control handbook. Gulf Professional Publishing, 2017.

Course Content

8.48 Petrochemical Waste management

COURSE CODE & TITLE (PGT-413) **Petrochemical Waste management**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the field of waste management, and hierarchy in waste management.	C-2	2
CLO-2	**Analyze** waste management in national practice, waste solidification/stabilization, and thermal treatment of waste.	C-4	3
CLO-3	**Evaluate** the challenges associated with petrochemical waste management in petroleum fields.	C-5	12
Lab Work Learning Outcome			
CLO-1	**Operate** the lab equipment that are used to estimate the water waste in petroleum fields.	P-3	4
CLO-2	**Conduct** the experiments on water to analyze the impurities.	P-4	5
CLO-3	**Participate** as an individual and as a group member in the lab related activities.	A-2	9
Course Outline for Theory			
Legislation in the field of waste management; Hierarchy in waste management and possibilities of applying the "circular economy" concept; Waste treatment procedures (chemical-physical, biological, thermal, waste disposal, waste conditioning, hazardous waste list); Waste management in national practice (mud pits, facilities for waste fluid regeneration); Toxicity of waste; Disposal of waste in or on the ground; Waste solidification/stabilization; Thermal treatment of waste; Waste disposal into caverns; Waste management during offshore exploration and production activities.			

Lab Outlines
Demonstration of waste treatment procedures for chemical-physical treatments
Demonstration of waste treatment procedures for biological treatments
Demonstration of waste treatment procedures for waste disposal and waste conditioning
Demonstration of waste treatment procedures for hazardous waste
Demon traction on waste management in national practice for mud pits
Demonstration on waste management in national practice for facilities for waste fluid regeneration
Demonstration on waste management in national practice for Toxicity of waste
Demonstration on disposal of waste in or on the ground and Waste solidification/stabilization
Demonstration on Thermal treatment of waste and waste disposal into caverns.
Demonstration on Waste management during offshore exploration and production.
Recommended Books
Jafarinejad, Shahryar. Petroleum waste treatment and pollution control. Butterworth-Heinemann, 2016.
Robertson, John O., and George V. Chilingar. Environmental aspects of oil and gas production. John Wiley & Sons, 2017.
Chandrasekaran, Srinivasan. Health, safety, and environmental management in offshore and petroleum engineering. John Wiley & Sons, 2016.

Course Content

8.49 Petroleum Resources & Reserves Estimation

COURSE CODE & TITLE (PGT-41x) **Petroleum Resources & Reserves Estimation**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** the concepts of possible and recoverable reserves.	C-3	2
CLO-2	**Apply** different equations for subsurface reserve and reservoir estimations.	C-4	3
CLO-3	**Evaluate** the appropriate reserve estimation techniques for different types of reservoirs.	C-5	4
Lab Work Learning Outcome			
CLO-1	**Interpret** the hydrocarbon recoverable and possible reserves from subsurface.	P-2	4
CLO-2	**Operate** the concerned tools and computational applications to achieve subsurface recoverable and possible volumes.	P-3	5
CLO-3	**Participate** as an individual and as a group member in the lab related activities.	A-2	9
Course Outline for Theory			
Estimating the choke performance: Single phase, multiphase, critical and sub-critical flow models, Deliverability of oil and gas wells: Principle of system analysis (NODAL Analysis) with simplified well configuration, Use of IPR (Inflow Performance Relationship) and TPR (Tubing Performance Relationship), Material balance and recovery strategies Estimating oil well rates under different drives mechanisms, Volatile oil Material Balance Equation (MBE), Calculation of original gas and condensate in place for volumetric gas condensate and volatile oil reservoirs, reserves calculations with and without compositional data, Case histories. Unconventional reservoirs. Shale gas, tight gas reservoirs, natural gas hydrates, coal bed methane, Geothermal reservoirs, and biogas generation in oil and gas wells			

Lab Outlines
To demonstrate basic laboratory experiments for black oil systems based on Bubble point evaluation.
To demonstrate basic laboratory experiments for black oil systems based on differential liberation.
To demonstrate the recommended procedure of PVT analysis for oil reservoirs.
To specify the fluid PVT for oil, gas, and water for an oil reservoir using the PVT software tool
To demonstrate the application of the material balance equation
To demonstrate the application of the volumetric equation
To simulate PVT experiments by entering real observed PVT data fluid system using the PVT software tool
To fit the equation of state by regression for the best fit between observed and estimated data using the PVT software tool
To find fluid in place and to identify the drive mechanism of a dry gas reservoir using a reservoir simulation software tool.
To history match, dry gas tank model using reservoir simulation software tool for more accurate information of fluid in place
Recommended Books
Mark P. Walsh and Larry W. Lake, “A Generalized Approach to Primary Hydrocarbon Recovery”, Volume 4, Elsevier, 2003.
Tarek Ahmed, “Reservoir Engineering Handbook”, Third Edition, Elsevier, 2006.
Brian F. Towle, “Fundamental Principles of Reservoir Engineering”

Course Content

8.50 Gas processing technology

COURSE CODE & TITLE (PGT-322) **Gas processing technology**	**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the properties and composition of natural gas, and processes to remove impurities.	C-2	2
CLO-2	**Compare** the natural gas processing techniques and its storage, transmission, and distribution facilities.	C-4	3
CLO-3	**Assess** the processes and techniques for gas quality improvement and gas flow metering.	C-5	4
Lab Work Learning Outcome			
CLO-1	**Operate** the relevant tools and computational applications to achieve outcomes of the gas process at the surface.	P-3	4
CLO-2	**Conduct** the composition and properties of natural gases and liquid HC's of Natural gases.	P-4	5
CLO-3	**Comply** to field safety regulations and guidelines.	A-2	7
Course Outline for Theory			
Properties of natural gas. Production, transportation, storage, and gauging of gas. Sales gas customer requirement. Gas field development, design of gathering systems, field treatment, and processing of natural gas, e.g.: gas dehydration and gas sweetening. Compressors and horsepower requirements. Flow through pipelines and pressure drops. Gas hydrates, LNG, Storage of natural gas. Gas to liquids (GTL). Gas metering separator selection. Natural gas field properties: Apparent molecular weight, Specific gravity, Compressibility factor, Density, Specific volume, Isothermal gas compressibility coefficient, Gas formation volume factor, Gas expansion factor, and Viscosity. Flow and compression techniques. Purification Processes: Sweetening, and dehydration of natural gas. Supply of Natural Gas: commissioning, transmission, and distribution. Transmission through Pipeline: Pipeline welding techniques, Testing and welding defects, Gas flow measurements, Introduction to LPG and LNG, Unaccounted for gas.			

Lab Outlines
Introduction to natural gas engineering and lab safety. Demonstration on the sampling of LPG and lighter hydrocarbon Gases. To determine the relative density or specific gravity of light hydrocarbon gas by thermo-hydrometer in a pressure hydrometer cylinder. To determine H2S in LPG by lead acetate method using an H_2S detector. To measure the flow rate of Natural gas by Dry Gas Meter. Measure the amount of Natural Gas by using Wet Gas Meter. To determine the vapor pressure of LPG by vapor pressure tester. Error determination of domestic gas meter by using portable gas test meter. To determine copper strip corrosion of LPG by copper corrosion strip test. To demonstrate the basic Amine Process for natural gas sweetening.
Recommended Books
William C. Lyons, Gary J Plisga, “Standard Handbook of Petroleum and Natural Gas Engineering”, Volume 1, Gulf Professional Publishing, 1996. Donald L. Katz, R. L. Lee, “Natural Gas Engineering Production and Storage”, McGraw-Hill New York, 1990. John M. Campbell, “Gas Conditioning and Processing”, ASIN: B000UMK60W James W. Amyx, “Petroleum Reservoir Engineering Physical Properties”, ISBN: 0070016003.

Course Content

8.51 Instrumentation and Process Control

CODE & TITLE (PGT-323) **Instrumentation and Process Control**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the chemical process in terms of a block diagram.		C-2	2
CLO-2	**Analyze** industrial instrumentation, temperature, flow level, composition measuring device, advanced measuring devices, etc., and Proportional Integral Derivatives (PIDs).		C-4	3
CLO-3	**Examine** transducers, control loops, and hardware elements of a control system.		C-5	4
Lab Work Learning Outcome				
CLO-1	**Understand** experimental procedures related to measurement and control.		P-3	4
CLO-2	**Participate** as an individual and as a group member in the lab related activities.		A-2	9
CLO-3	**Report** summarized experimental data and results.		A-3	10
Course Outline for Theory				

Instrumentation: Principles of measurement of temperature, Pressure level, flow, weight Power, speed, position; etc, Study of common sensors, transmitters, controllers, actuators, recorders, switches, etc, Methodology for calibration, Failsafe modes of operation, alarm, trip and interlock system, Emergency shut-down systems, Fire and gas detection, Pressure relief and venting systems, Measurement of liquid

Introduction to Controllers and final control element: Control Valve, Proportional controller, Integral & Derivative controller, Components of the control system, block diagram, Negative and Positive feedback, Servo problem and Regulation Problem, Understanding of Block diagram: Proportional control for set point change,

Proportional control for load change, Proportional Integral control for load change, Proportional Integral Control for set point change
Lab Outlines
Study the basis of instrumentation and process control system lab, Study feed-forward and feed-backward control loop, Manually control the pH in the process tank by controlling the flow rates of reagent and effluent, Study the opening v/s flow characteristics of the control valve, Study the operation of the solenoid and servo control valves, Study the operation of Centrifugal pump, Manual valve, Visual flow meter, and Servo valve, Study the Calibration of a pressure gauge using a dead weight calibrator, Study the Preparation of instrument air, free of dust and moisture to control the operation of instruments by using pressure control rig, Study and determine the level of a tank by using the level sensor in Level demonstration unit
Recommended Books
Coughanower D. R., “Process System Analysis and Control”, 2nd Edition, McGraw Hill. (1991). Seborg, E., Mellichamp, “Process Dynamics & Control”, 2nd Edition, John Wiley, (2004). Stephanopoulos, “Chemical Process Control-An Introduction to Theory & Practice”,1st Edition, Prentice Hall Inc. Eckman D. P., “Industrial Instrumentation”, Wiley Eastern Ltd., (1975). Kerk F. W., Rimboi W., Tarapore R., “Instrumentation”, Wiley and Sons, (1983).

Course Content

8.52 Flow Assurance

COURSE CODE & TITLE (PGT-41x) Flow Assurance		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the flow assurance problem, inorganic oilfield, scale principles, and fundamentals.		C-2	2
CLO-2	**Analyze** the procedures that are concerned with flow assurance.		C-4	3
CLO-3	**Evaluate** the challenges associated with flow assurance in field applications.		C-5	4
Lab Work Learning Outcome				
CLO-1	**Operate** Flow Assurance using different software, tools, and equipment.		P-3	4
CLO-2	**Conduct** various experimental work and computations related to Flow Assurance.		P-4	5
CLO-3	**Comply** to field safety regulations and guidelines.		A-2	7
Course Outline for Theory				
The flow assurance problem, Inorganic oilfield scale principles, and fundamentals, Compound types, Prediction and modeling of inorganic scales, Recent development in scale prevention, Hydrates Characteristics, Hydrate Mechanisms, Control, prevention, and remediation, Wax thermodynamic prediction, Modeling Asphaltene Behavior, Hydrate prediction model, Formation of emulsions, Emulsion destabilization processes, Corrosion classification, and mechanism, CO2 and H2S corrosion, Corrosion control and inhibitor guidelines, Oilfield corrosion management guidelines				

Lab Outlines
Demonstration of the flow assurance problem and safety concerns Demonstration on inorganic oilfield scale principles and fundamentals Demonstration on recent development in the scale prevention Demonstration on hydrates characteristics, mechanisms, control, prevention Demonstration on wax thermodynamic prediction and modeling asphaltene behavior Demonstration on the formation of emulsions and emulsion destabilization processes Demonstration on corrosion classification and mechanism, Demonstration on CO2 and H2S corrosion, Demonstration on corrosion control and inhibitor guidelines, Demonstration of oilfield corrosion management guidelines
Recommended Books
Wu, Yu-Shu. Multiphase fluid flows in porous and fractured reservoirs. Gulf professional publishing, 2015. Sun, Baojiang. Multiphase Flow in Oil and Gas Well Drilling. John Wiley & Sons, 2016. Gudmundsson, Jon Steinar. Flow assurance solids in oil and gas production. CRC Press, 2017.

Course Content

8.53 Flow in Porous Media

COURSE CODE & TITLE (PGT-41x) **Flow In Porous Media**		**CREDIT & CONTACT HOURS** (2+1) **32 Theory + 48 Lab**	**KNOWLEDGE AREA/ DOMAIN** **Petroleum & Gas Engineering Technology (Depth)**	
After completion of this course, students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** porosity, permeability, flow equations for single and multi-phase flow in porous rocks.		C-2	2
CLO-2	**Apply** appropriate equations to assess flow in porous media.		C-3	3
CLO-3	**Recommend** techniques of measuring the multiphase flow through porous media.		C-5	4
Lab Work Learning Outcome				
CLO-3	**Operate** Flow in Porous Media using different software, tools, and equipment.		P-3	5
CLO-4	**Conduct** various experimental work and computations related to Flow in Porous Media.		P-4	4
CLO-3	**Participate** as an individual and as a group member in the lab related activities.		A-2	9
Course Outline for Theory				
Porosity, permeability, flow equations for single- and multi-phase flow, capillary pressure, relative permeability and applications in earth sciences and petroleum engineering, Geometry of porous media- Porosity and the packing of spheres- Real Rocks, porosity distributions, correlations, sedimentary processes, Fractals, Hydrodynamics- Navier Stokes equation- Examples of low Raynold number flows Darcy's law- Karman-Kozeny- Capillarity, droplets and Laplace law, Youngs law and wetting- Examples of multi-phase flows Capillary dominated flow in porous media. Flow transitions, Boundary and initial conditions, wall channeling, poroelasticity and poroplasticity, porous medium interconnections, petrophysical properties of porous media, and multiphase flow through porous media. Thermal flow through porous media				

Lab Outlines
Demonstration on Petrophysics of porous media Demonstration on flow regimes for single- and multi-phase flow, Demonstration on capillary pressure, relative permeability Demonstration on Geometry of porous media Demonstration on Porosity and the packing of sediments Demonstration of porosity distributions through sedimentary processes Demonstration on Fractals and Hydrodynamics of porous media Demonstration on low Raynold number flows in rocks Demonstration on Darcy's law and Karman-Kozeny- Capillarity Demonstration on droplets and Laplace law, Demonstration on Youngs law and wetting- Demonstration on multi-phase flows Capillary dominated flow in porous media
Recommended Books
Xue, Liang, Xiaozhe Guo, and Hao Chen. Fluid Flow in Porous Media: Fundamentals and Applications. 2021. Wu, Yu-Shu. Multiphase fluid flows in porous and fractured reservoirs. Gulf professional publishing, 2015. Sun, Baojiang. Multiphase Flow in Oil and Gas Well Drilling. John Wiley & Sons, 2016.

9. Supervised Industrial Training (SIT)

9.1 Background

Supervised Industrial Training (SIT) refers to students supervised hands-on experience in an environment where engineering is practiced, familiarizing them with professional engineering work prior to graduation. The training curriculum consists of a minimum of 16 weeks of continuous industrial training, comprised of 8 hours per day, 5 working days per week. A Bachelor of Engineering Technology student shall undergo mandatory SIT during the 8th semester (16 weeks), or 7th and 8th semesters (16 weeks mandatory and 16 weeks in 7th semester optional), after he/ she has passed all subjects up to the 6th semester.

SIT covers a range of activities, such as design implementation, production processes, laboratory experiments, on-site field works and maintenance. It also serves as a mechanism to integrate engineering practices and the curriculum to achieve Program Learning Outcomes that cover Engineering Technologists Graduate Attributes in line with the Sydney Accord. While SIT provides practical exposure to engineering processes and helps develop professional skills required for an Engineering Technologist, it also offers an opportunity to prospective employers to assess potential skills of a future employee.

9.2 Objectives

Through the SIT, students will:

a. Learn to apply engineering technology knowledge learned in classroom environment in real industrial situations.
b. Be provided exposure to professional practices in the industries.
c. Understand the role and responsibilities and code of ethics that Engineering Technologists should uphold.
d. Develop awareness about general workplace behavior and build interpersonal skills.
e. Maintain professional work records and reports.
f. Learn to write reports and network with probable future employers to increase employability.

9.3 Responsibility of HEI: Placement in SIT Program

During 7th (Optional) and 8th Semester, Bachelor of Petroleum & Gas Engineering Technology students will undergo continuous SIT of 16 (or 32) weeks. This training shall be arranged by HEIs in leading industry, and preferably should sign an MoU for the SIT. A designated Administrator/Coordinator of HEI shall complete all necessary documentation, preferably 12 weeks prior to the commencement of the training, and issue Training Schedule for 16 (or 32) weeks so that all stakeholders and the students are aware and assured of undergoing SIT training in 7th (optional) and 8th semester according to a scheduled timeline.

9.4 Responsibilities of Students:

a. Bachelor of Petroleum & Gas Engineering Technology students shall get enrolled for SIT during the 6th semester and before commencement of 7th semester.
b. Students shall have to undergo continuous training of 16 (or 32) credit hours. One week's training of 8 hours daily for 5 days (40 contact hours) will be counted as 1 credit hour. Accordingly, 16 weeks (One semester) will help earn students 16 credit hours.
c. Total contact hours per semester are: 16 weeks per semester x 5 working days per week x 8 hours per day = 640. If an HEI opts SIT in 2 semesters (7th and 8th), these credit hours and contact hours will be doubled.

d. Students will maintain a daily Logbook, signed by the SIT supervisor at site, Training Administrator appointed by HEI and the student.
e. Students must observe safety & security rules of the Organization where they receive Training.
f. Students must wear specified working dress during training.
g. Students must obey all rules and regulations of the organization.
h. Students must observe working timings of the training Organization. Students may be allowed 10 days leave during the training period of 16 (or 32) weeks for genuine reasons. The leave shall only be used to cater for emergencies, with prior sanction from the training Administrator/Coordinator.
i. Leave will be deducted from training hours and required to be made up later.
j. Unsanctioned leaves shall be treated as "absent", and liable to disciplinary action.
k. Public holidays and leave should not be counted as working hours.

9.5 Training Progress Assessment and Review by HEI

Every HEI should appoint a focal person as SIT Administrator/Coordinator for each program who will monitor progress randomly through site visits, phone calls or emails to the industrial organization's counterpart focal person. Progress reports will be maintained after coordination with training supervisor(s) as well as the students.

The purpose of monitoring of SIT by Training Administrator/Coordinator are:

a. To ensure the training organization is providing suitable and appropriate training to students.
b. To obtain feedback on students' performance and training progress through discussion with training supervisor(s).
c. To make courtesy visits and establish industrial relations between the HEI and the industries where students will receive their SIT.
d. To discuss the possibility of students' job placement with the training organization.
e. To survey new industries as potential training placement locations in the future.

9.6 Changing Student Placement During SIT

a. Students are discouraged to change placement during the training period from one organization to another.
b. However, written permission may be granted by the training Administrator/Coordinator, if a new placement of the student is available and confirmed in another organization, provided the student does not suffer loss of training hours due to this changeover.
c. After getting written permission from the Training Administrator/Coordinator, a fresh approval should be applied for the new placement.

9.7 Daily Training Logbook

All training activities must be recorded daily in the Training Logbook [See Appendix F]. Students must get it signed, daily, by on-the-job Trainer.

The Training logbook must reflect:

a. The student's learning experience during the industrial training

b. Training records and evidence of supervised training, with evidence of participation of student, on- the-job Trainer and HEI's training Administrator/Coordinator.
c. Part of professional practice in engineering profession where incidence and evidence are properly documented.
d. Information that becomes a source of reference in preparing the Industrial Training Report [See Section 8.8].
e. The Logbook must be submitted along with the Industrial Training Report.

9.8 Industrial Training Report

An Industrial Training Report will be submitted upon completion of SIT. The Report must describe a student's learning and development in technical knowledge, engineering practices and professional skills acquired through practical experience. The Industrial Training Report should also reflect a student's ability in communication skills and understanding of engineering practices. Students should seek advice from their on-the-job Trainer on site, to ensure that no confidential materials are included in the report. The report shall be submitted to the Training Administrator. The student may present a copy of the report to the prospective employer. Any references made in preparation of the report should be recognized using standard referencing formats. Students should refer to the Industrial Training Report Template as provided [See Appendix G] and guidelines given below in preparing the Report. The Daily Training Logbook should be submitted together with the Report.

9.9 Guidelines for Preparation of Industrial Training Report

Under the guidance of supervisors, students need to properly document their experience and learning during the SIT in the form of an Industrial Training Report. A properly prepared Report can portray their practical experience precisely in an orderly manner. The Report must be prepared according to the format and the guidelines below:

9.9.1 Contents of Industrial Training Report

(a) Table of Contents

This section of the report shall consist of:

i. Headings
ii. Sub-headings
iii. Page numbers

Every appendix requires a title, and each page needs to be numbered accordingly.

(b) Background & Profile of the Training Organization

Brief and concise description of the organization in which the student is undertaking the SIT. The main items are:

i. Backgrounds/profile of the organization
ii. Vision and Mission
iii. Organogram.
iv. Title and position of the supervisor in charge
v. Other necessary information only (not more than three pages)

(c) Schedule of Duties Performed as Trainee

This section briefly describes the time, duration and types of duties performed during the training. The description must follow the schedule of the training, i.e., in chronological order (for 16/32 weeks). The days when the student was not on duty must be properly recorded with cogent reasons.

(d) Experience During SIT

In this section, the student must fully describe the industrial training experience gained. Some suggested areas include:

i. Project (s) carried out, if any.
ii. Supervisory works
iii. Problems encountered
iv. Problems solving process or approach
v. Hands-on skills acquired.
vi. How productivity can be further enhanced.
vii. Quality Management system in place.
viii. Safety at work.

(e) Conclusion

Students provide an overall assessment in this section and arrive at a conclusion with regards to the SIT undergone. Content may include:

i. Types of major work performed during SIT
ii. Different modules of SIT
iii. Comments whether SIT met the training objectives
iv. Suggestions and recommendations for improvement of the SIT

(f) References

A complete list of the references used in the report must be included according to standard referencing format.

(g) Appendixes

Appendixes are additional information appended to support the main text of the Report. A copy of the letter of permission from the Training Organization must be attached as an appendix. Other suggested appendixes are:

i. Investigation and project report during SIT
ii. Technical drawings, so far these are not secret documents or proprietary etc.
iii. Any other document that adds to the Report

(h) Figures and Tables

All figures, tables and similar content must be captioned, labeled, and mentioned in the main text of the Report.

(i) Notations, Symbols & Acronyms

If the report contains notations, symbols, and acronyms, these must be defined before they first appear in the main text. It is good practice to put a list of notations, symbols, and acronyms on a separate page, appropriately titled, and placed after 'Tables of Contents' page.

Every appendix must have a title and be mentioned in the main text of the Report. All page numbers for appendixes must be in continuation of page numbers of the main Report.

9.9.2 Format of the Report

(a) General

i. Students are advised to start writing the SIT Report as soon as training commences to ensure timely completion and submission.

ii. Do not include irrelevant materials, e.g., brochures from the organizations, or any publicity materials in the report.
iii. The Report must be typewritten on plain white A4 size paper, with 12-point Times New Roman font type and line spacing of 1.5.

(b) Abstract or Preface

The Report should start with an abstract of maximum 2 pages, and should briefly describe:

i. Description of Organization providing SIT
ii. Summary of the Report
iii. Acknowledgements

9.10 SIT Assessment

Assessment of the SIT should be based on the following parameter:

i.	On-the-Job Trainer Report	(20% marks)
ii.	HEI's Training/ Advisor Report through visits or survey	(10% marks)
iii.	Industrial Training Report	(50% marks)
iv.	Viva voce	(20% marks)

It is also be noted that:

i. A minimum of 50% marks are required to pass the SIT.
ii. Students are advised to be diligent in writing their Report.
iii. The Report must be of good quality and portray in full the industrial experience and knowledge gained.
iv. The Report should not be in the form of short notes and figurative form.
v. If the Report is not satisfactory, students shall rewrite the Report until it is deemed satisfactory.

9.11 Completion of Industrial Training

i. Upon completion of a 16- or 32-week continuous SIT, a Confirmation Letter to this effect must be obtained from the training organization and/or probable employer.

ii. The Confirmation Letter must be submitted to the Industrial Training Administrator/Coordinator, together with the (1) On-the-Job Trainer's Report, (2) Student Feedback Form, and (3) Industrial Training Report for grading.

APPENDIX A: Sydney Accord Knowledge and Attitude Profile

(Retrieved from www.ieagreements.org)

A Sydney Accord program provides:
SK1: A systematic, theory-based understanding of the natural sciences applicable to the sub-discipline and awareness of relevant social sciences.
SK2: Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed consideration and use of models applicable to the sub-discipline.
SK3: A systematic, theory-based formulation of engineering fundamentals required in an accepted sub-discipline.
SK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for an accepted sub-discipline.
SK5: 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 using the technologies of a practice area.
SK6: Knowledge of engineering technologies applicable in the sub-discipline.
SK7: Knowledge of the role of technology in society and identified issues in applying engineering technology, such as public safety and sustainable development (represented by the 17 UN-SDGs).
SK8: Engagement with the current technological literature of the discipline and awareness of the power of critical thinking.
SK9: 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.

APPENDIX B: Engineering Technologist Graduate Attribute Profile

(Retrieved from www.ieagreements.org)

As per Sydney Accord, Engineering Technologist Graduate is expected to have the following attributes:
Engineering Technology Knowledge: **SA1:** An ability to apply knowledge of mathematics, natural science, Engineering Technology fundamentals and Engineering Technology specialization to defined and applied Engineering Technology procedures, processes, systems, or methodologies.
Problem Analysis **SA2:** An ability to Identify, formulate, research literature and analyze broadly-defined Engineering Technology problems reaching substantiated conclusions using analytical tools appropriate to the discipline or area of specialization.
Design/Development of Solutions **SA3:** An ability to design solutions for broadly- defined Engineering Technology problems and contribute to the design of systems, components or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
Investigation **SA4:** An ability to conduct investigations of broadly defined problems; locate, search and select relevant data from codes, data bases and literature, design and conduct experiments to provide valid conclusions.
Modern Tool Usage **SA5:** An ability to Select and apply appropriate techniques, resources, and modern technology and IT tools, including prediction and modelling, to broadly-defined Engineering Technology problems, with an understanding of the limitations.
The Engineering Technologist and Society **SA6:** An ability to demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to Engineering Technology practice and solutions to broadly defined Engineering Technology problems.
Environment and Sustainability **SA7:** An ability to understand and evaluate the sustainability and impact of Engineering Technology work in the solution of broadly defined Engineering Technology problems in societal and environmental contexts.
Ethics: **SA8:** Understand and commit to professional ethics and responsibilities and norms of Engineering Technology practice.
Individual and Teamwork **SA9:** An ability to Function effectively as an individual, and as a member or leader in diverse teams.

Communication **SA10:** An ability to communicate effectively on broadly defined Engineering Technology activities with the Engineering Technologist community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
Project Management **SA11:** An ability to demonstrate knowledge and understanding of Engineering Technology management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments.
Lifelong Learning: **SA12:** An ability to recognize the need for and have the ability to engage in independent and life-long learning in specialist Engineering Technologies.

APPENDIX C: Engineering Technologist Professional Competence Profile

(Retrieved from www.ieagreements.org)

As per Sydney Accord, Engineering Technologist Graduate is expected to demonstrate the following competencies:
Comprehend and apply universal knowledge: **TC1:** Comprehend and apply the knowledge embodied in widely accepted and applied procedures, processes, systems, or methodologies.
Comprehend and apply local knowledge: **TC2:** Comprehend and apply the knowledge embodied procedures, processes, systems, or methodologies that is specific to the jurisdiction of practice.
Problem analysis: **TC3:** Identify, clarify, and analyze broadly defined problems using the support of computing and information technologies where applicable.
Design and development of solutions: **TC4:** Design or develop solutions to broadly defined problems considering a variety of perspectives.
Evaluation: **TC5:** Evaluate the outcomes and impacts of broadly defined activities.
Protection of society: **TC6:** Recognize the foreseeable economic, social, and environmental effects of broadly defined activities and seek to achieve sustainable outcomes (represented by the 17 UN-SDGs).
Legal, regulatory, and cultural: **TC7:** Meet all legal, regulatory, and cultural requirements and protect public health and safety during all activities.
Ethics: **TC8:** Conduct activities ethically
Manage engineering activities: **TC9:** Manage part or all of one or more broadly defined activities.
Communication and Collaboration: **TC10:** Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders during all activities.
Continuing Professional Development (CPD) and Lifelong learning: **TC11:** Undertake CPD activities to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever-changing nature of work.

Judgement: **TC12:** Choose appropriate technologies to deal with broadly defined problems. Exercise sound judgement in the course of all broadly defined activities.
Responsibility for decisions: **TC13:** Be responsible for making decisions on part or all of one or more broadly defined activities.

APPENDIX D: Minutes of Preliminary Meeting of NCRC

The preliminary meeting of National Curriculum Review Committee (NCRC) was held on 28-09-2022 to 30-09-2022, at the University of Chakwal.

Welcome session started with recitation of Holy Quran, and it was chaired by Prof. Dr. Mohammad Bilal Khan, Vice Chancellor, Chakwal university. Honorable Engr. Imtiaz Hussain Gilani, Chairman NTC, attended the meeting online. In a welcome speech, objectives, and arrangements for NCRC were presented by the host Honorable Vice Chancellor. The Chairman NTC explicitly elaborated importance of curriculum development for engineering technology programs with sharper focus on practical work, and keeping a futuristic outlook, market demand, and societal needs. The curriculum must follow NTC guidelines, aligned with HEC Undergraduate Policy framework, and be substantially compliant with the Sydney Accord protocols.

Hafiz Ghulam Muhammad represented NTC.

In the second session, the house nominated the Convener, Co-Convener, Secretary and Co-Secretary of the NCRC for smooth functioning. After discussion with members, Engr. Prof. Dr. Saeed Gul was nominated as Convenor, and Engr. Prof. Dr. Asadullah Khan was nominated as Co-Convener. Engr. Dr. Ubedullah Ansari and Engr. Dr. Tazien Rashid were nominated as Secretary and Co-Secretary for the Committee, respectively.

The following nominated members represented various HEIs from all over the Pakistan were Members of the NCRC for Bachelor's Degree in Petroleum & Gas Engineering Technology:

Sr#	NCRC Members	Role
1	Engr. Prof. Dr. Saeed Gul Professor and HoD, University of Engineering & Technology, Peshawar	Convener
2	Engr. Prof. Dr. Asadullah Khan Professor and Dean, Baluchistan University of Information, Technology, Engineering & Management Sciences, Quetta	Co-Convener
3	Engr. Dr. Ubedullah Ansari Assistant Professor, Mehran University of Engineering & Technology, Jamshoro	Secretary
4	Engr. Dr. Tazien Rashid, Associate Professor and HoD Government Collage University, Faisalabad	Co-Secretary
5	Engr. Prof. Dr. Abdul Aziz Mazhar Former Dean, Institute of Space Technology, Islamabad	Member
6	Engr. Prof. Dr. Amir Sultan Professor, University of Engineering & Technology, Taxila	Member
7	Engr. Prof. Dr. Khurram Shahzad Baig Professor and HoD, University of Wah, Wah Cantt	Member
8	Engr. Prof. Dr. Shahab Khushnood Professor, University of Wah, Wah Cantt	Member
9	Engr. Dr. Nasir Khan Assistant Professor and HoD,	Member

Sr#	NCRC Members	Role
	University of Chakwal, Chakwal	
10	Engr. Dr. Asif Nadeem Tabish Associate Professor, University of Engineering & Technology, Lahore, Kala Shahkaku Campu	Member
11	Mr. Hidayatullah Kasi Deputy Director, Academics Division, HEC, Pakistan	HEC Representative
12	Mr. Muhammad Fahd Amin, Acting Registrar, NTC, Pakistan	NTC Representative
13	Mr. Hafiz Ghulam Muhammad NTC, Pakistan	NTC Representative

After taking charge by the nominated committee, convenor, Engr. Prof. Dr. Saeed Gul chaired the meeting and emphasized to ensure the reflection of Sydney Accord in curriculum and course titles as well as to develop curriculum that provides a unified framework for offering degrees under the title of Petroleum & Gas Engineering Technology.

In next session, the house openly discussed the nomenclature of the discipline, preface, objectives of the programs, PLOs, methods of instruction and learning environment, assessment, and operational framework.

After long deliberation, the Committee proposed the curriculum framework, the duration of the program, number of semesters, number of weeks per semester, total number of credit hours, weightage of technology domain and non-technology domain courses and weightage of theory and practical of undergraduate 4-years program in Petroleum & Gas Engineering Technology. Furthermore, list of courses (core and elective) and semester wise breakup of courses were also discussed thoroughly and finalized.

Admission and intake criteria were discussed and adopted as defined in NTC Accreditation Manual. Supervised industrial training (SIT) was discussed in detail. There was a consensus that SIT will be mandatory for 8th Semester.

Those HEI's that can provide only one semester of SIT (in 8^{th}), shall offer optional courses instead of SIT in the 7^{th} semester to cover credit hours and other requirements. HEI's that are geared to provide SIT in two semesters can do this in 7^{th} and 8^{th} Semesters.

In line with the experience and expertise of NCRC members, Sub- committees were formed. The list of courses of various domains was distributed among the Sub-Committees. These Committees were assigned responsibility for reviewing course objectives, adding course learning outcomes, appropriate mapping with taxonomy and PLOs, updating list of contents, adding teaching-learning methods and assessment, and updating bibliography/ references/ suggested books.

After conclusion of the preliminary meeting, the Sub-Committees submitted the proposed course contents for theory and practical's, along with CLOs, list of recommended books, list of experiments and relevant information of each course. The first draft was compiled by the Engr. Dr. Ubedullah Ansari, Secretary NCRC, and distributed to Members for review. Preliminary curriculum draft was submitted to NTC and sent to international reviewers.

APPENDIX E: Minutes of the Final Meeting of NCRC

The Final meeting of the NCRC was held on November 23rd to 25th 2022 at the University of Technology Nowshera. The inauguration session was started with recitation of Holy Quran, and chaired by Honorable Engr. Imtiaz Hussain Gilani, Chairman NTC. The Vice Chancellor of the university of Nowshera, Dr. Zaffar M. Khan, was also present at the meeting.

Engr. Imtiaz Hussain Gilani, Chairman NTC, appreciated the efforts by Members and highlighted their valuable contribution for the national cause in setting standards for quality-education in Petroleum & Gas Engineering Technology. The Vice Chancellor of the host university also extended his gratitude to the entire team and briefed them on the objectives and arrangements for the final NCRC. Mr. Hafiz Ghulam Muhammad represented NTC. The following members attended the meeting:

Sr#	NCRC Members	Role
1	Engr. Prof. Dr. Saeed Gul Professor University of Engineering & Technology, Peshawar	Convener
2	Engr. Prof. Dr. Asadullah Khan Professor and Dean, Baluchistan University of Information, Technology, Engineering & Management Sciences, Quetta	Co-Convener
3	Engr. Dr. Ubedullah Ansari Assistant Professor, Mehran University of Engineering & Technology, Jamshoro	Secretary
4	Engr. Dr. Tazien Rashid, Associate Professor and HoD Government Collage University, Faisalabad	Co-Secretary
5	Engr. Prof. Dr. Abdul Aziz Mazhar Former Dean, Institute of Space Technology, Islamabad	Member
6	Engr. Prof. Dr. Amir Sultan Professor, University of Engineering & Technology, Taxila	Member
7	Engr. Prof. Dr. Khurram Shahzad Baig Professor and HoD, University of Wah, Wah Cantt	Member
8	Engr. Prof. Dr. Shahab Khushnood Professor, University of Wah, Wah Cantt	Member
9	Engr. Dr. Nasir Khan Assistant Professor and HoD, University of Chakwal, Chakwal	Member
10	Engr. Dr. Asif Nadeem Tabish Associate Professor, University of Engineering & Technology, Lahore, Kala Shahkaku Campu	Member
11	Dr. Abdul Hanan Zahid Lecturer, University of Gujrat	

Sr#	NCRC Members	Role
12	Mr. Hafiz Ghulam Muhammad NTC, Pakistan	NTC Representative

After the introductory session, deliberations on the agenda of the second meeting formally commenced, which was headed by Convener Engr. Prof. Dr. Saeed Gul. Honorable Members were informed that valuable feedback was received from the following international experts:

1. Engr. Dr. Li Qingchao, Henan polytechnic university, China
2. Engr. Dr. Qazi Adnan Ahmad, Department of Earth System Sciences, South Korea

In this regard, international experts appreciated the efforts made by NCRC to compose a balanced and standardized curriculum for Petroleum & Gas Engineering Technology. Their proposed suggestions were incorporated in the curriculum, particularly the sub engineering fields of “Well logging” and “Well testing” were merged into “formation evaluation” as breath course of 2 theory credit hours and 1 practical credit hour. Various issues were thoroughly deliberated upon by Members of NCRC in Sub-Committees, and honorable members submitted the following resolutions:

Agreed upon curriculum preface, mission, vision, preamble, rationale, scope, course scheme etc. Finalized bench marking of Recommended Scheme of Studies, Engineering Technology domain and non-Engineering technology domain courses in comparison with framework and list of Electives as defined earlier. Approved the Semester-wise break-up of courses, credit hours allocations and Breadth and Depth courses. Recommended sample course profiles and contents. Recommend sample weekly lecture plan and laboratory work for Foundation and Breath courses.

The final draft was compiled by Secretary Engr. Dr. Ubedullah Ansari and Co-Secretary Engr. Dr. Tazien Rashid. After review by Members and with the approval of Convener Engr. Prof. Dr. Saeed Gul and Co-Convener Engr. Prof. Dr. Asadullah Khan, it was submitted to NTC.

APPENDIX F: Supervised Industrial Training Logbook Sample Format

Student Details:
Name:
Roll Number:
Address:
Email:

Course of Study:
Year/Semester of Study:

Training Start Date:
Training End Date:

Training Organization Details:

Name of Organization:
Address:

Contact Person:
Contact Number:

On-the-job Trainer Name:
On-the-job Trainer Contact Number:

Daily Training Log

Please specify training information by descriptive statements, tables, sketches, figures, photographs, and so forth. Feel free to incorporate attachments wherever necessary.

Training Week: _____

Date	Time	Training Log

I, _____ Roll Number_____, do hereby declare that all information provided above is true and correct to the best of my knowledge.

_____
Student signature with date

_____ _____
Organization Supervisor signature with date HEI Coordinator signature & date

APPENDIX G: Supervised Industrial Training Report Sample Format

Sample table of content for supervised industrial training report is provided so that students can develop an understanding of what is expected of them when making the submission. Students are encouraged to expand upon the content presented below. A declaration page validating the originality of work duly signed by the student and the trainee is also to be attached at the beginning of the submitted report.