

**CURRICULUM OF  
PETROLEUM AND GAS  
ENGINEERING  
FOR  
BACHELOR & MASTER  
DEGREE PROGRAMS**

(Revised 2017)



**HIGHER EDUCATION COMMISSION  
ISLAMABAD**

## **CURRICULUM DIVISION, HEC**

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## PREFACE

The curriculum, with varying definitions, is said to be a plan of the teaching-learning process that students of an academic programme are required to undergo to achieve some specific objectives. It includes scheme of studies, objectives & learning outcomes, course contents, teaching methodologies and assessment/ evaluation. Since knowledge in all disciplines and fields is expanding at a fast pace and new disciplines are also emerging; it is imperative that curricula be developed and revised accordingly.

University Grants Commission (UGC) was designated as the competent authority to develop, review and revise curricula beyond Class-XII vide Section 3, Sub-Section 2 (ii), Act of Parliament No. X of 1976 titled "Supervision of Curricula and Textbooks and Maintenance of Standard of Education". With the repeal of UGC Act, the same function was assigned to the Higher Education Commission (HEC) under its Ordinance of 2002, Section 10, Sub-Section 1 (v).

In compliance with the above provisions, the Curriculum Division of HEC undertakes the revision of curricula regularly through respective National Curriculum Revision Committees (NCRCs) which consist of eminent professors and researchers of relevant fields from public and private sector universities, R&D organizations, councils, industry and civil society by seeking nominations from their organizations.

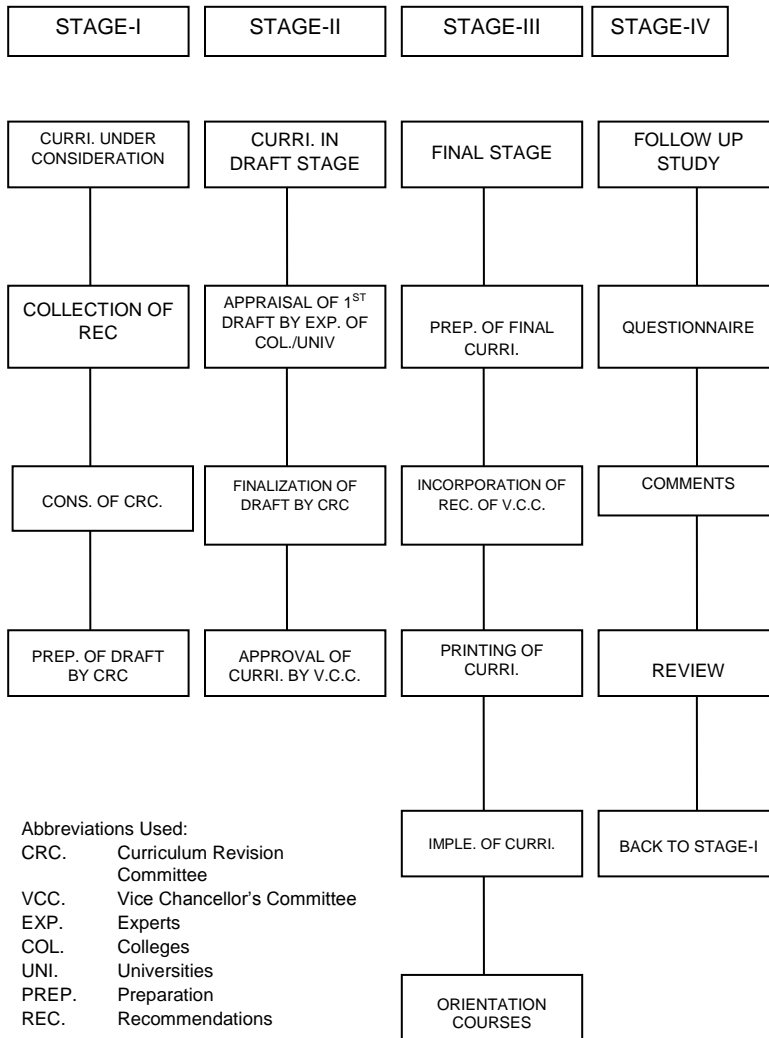
In order to impart quality education which is at par with indigenous needs and international standards, HEC NCRCs have developed unified framework/ templates as guidelines for the development and revision of curricula in the disciplines of Basic Sciences, Applied Sciences, Social Sciences, Agriculture and Engineering.

It is hoped that this curriculum document, prepared by the respective NCRC's, would serve the purpose of meeting our national, social and economic needs, and it would also provide the level of competency specified in Pakistan Qualification Framework to make it compatible with international educational standards. The curriculum is also placed on the website of HEC

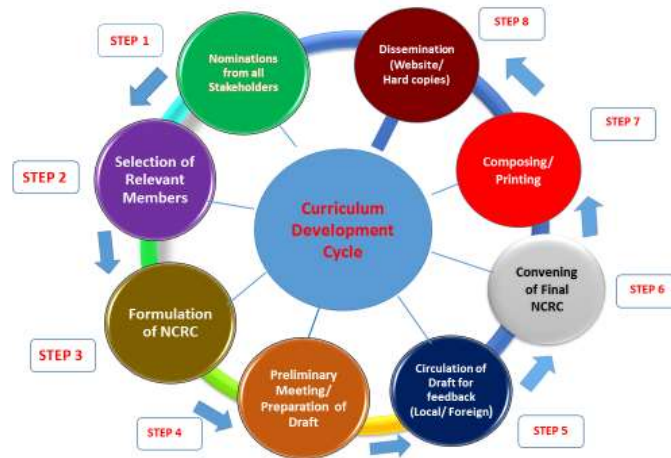
<http://hec.gov.pk/english/services/universities/RevisedCurricula/Pages/default.aspx>

**(Muhammad Raza Chohan)**  
**Director General (Academics)**

## CURRICULUM DEVELOPMENT PROCESS



## CURRICULUM DEVELOPMENT CYCLE



## INTRODUCTION

1. The two meetings of 4<sup>th</sup> National Curriculum Revision Committee in the subject of Petroleum and Gas Engineering was held from January 25-27, 2017 at HEC Regional Centre, Karachi (preliminary meeting) and May 15-17, 2017 at HEC Regional Centre, Lahore (final meeting). The purpose of the meetings was to present the final curriculum of Petroleum and Gas Engineering. Following members attended the meeting:
  - i. Prof. Dr. Abid Murtaza Khan, Convener  
Professor / Chairman,  
Department of Petroleum Engineering,  
NED University of Engineering and Technology,  
Karachi.
  - ii. Prof. Dr. Engr. Abdul Haque Tunio, Co-Convener  
Professor / Director,  
Institute of Petroleum and Natural  
Gas Engineering,  
Mehran University of Engineering and Technology,  
Jamshoro.
  - iii. Dr. Engr. Muhammad Khurram Zahoor, Member  
Associate Professor / Chairman,  
Department of Petroleum and Gas Engineering,  
University of Engineering and Technology, Lahore.
  - iv. Dr. Engr. Javeed Ashraf Awan, Member  
Associate Professor,  
Institute of Chemical Engineering and Technology,  
University of the Punjab, Lahore.
  - v. Dr. Engr. Faisal Mushtaq, Member  
Assistant Professor / Chairperson,  
Department of Petroleum and Gas Engineering,  
Balochistan University of Information Technology,  
Engineering and Management Sciences, Quetta.
  - vi. Dr. Engr. Arshad Shehzad Ahmad Shahid Member  
Assistant Professor / Head of Department,  
Department of Petroleum and Gas Engineering,  
NFC Institute of Engineering and Technology, Multan.
  - vii. Dr. Engr. Amanat Ali Bhatti, Member  
Assistant Professor,  
Department of Petroleum and Gas Engineering,  
University of Engineering and Technology, Lahore.

- |       |  |           |
|-------|--|-----------|
| viii. | Dr. Engr. Javed Haneef,<br>Assistant Professor,<br>Department of Petroleum Engineering,<br>NED University of Engineering and Technology,<br>Karachi.   | Member    |
| ix.   | Dr. Engr. Iftikhar Ahmad,<br>Assistant Professor,<br>Department of Chemical Engineering,<br>National University of Sciences and Technology,<br>Islamabad.                                      | Member    |
| x.    | Engr. Bharat Kumar Harani,<br>Assistant Professor,<br>Department of Petroleum and Gas Engineering,<br>Dawood University of Engineering and Technology,<br>Karachi.                             | Member    |
| xi.   | Engr. Imtiaz Ali,<br>Assistant Professor,<br>Department of Petroleum and Gas Engineering,<br>Balochistan University of Information Technology,<br>Engineering and Management Sciences, Quetta. | Member    |
| xii.  | Engr. Muhammad Owais Naseem,<br>Senior Engineer Drilling,<br>Drilling and Well Engineering Department,<br>Pakistan Petroleum Limited, Karachi.   | Member    |
| xiii. | Engr. Muhammad Baber Siddiqui,<br>General Manager,<br>Projects, Facilities, Maintenance and Development,<br>Pakistan State Oil, Karachi.   | Member    |
| xiv.  | Engr. Qamar Saqlain Anjum,<br>Senior Executive Operations,<br>ZE Central, Pakistan State Oil Company, Lahore.  | Member    |
| xv.   | Engr. Faisal Ur Rahman Awan,<br>Lecturer,<br>Department of Petroleum and Gas Engineering,<br>Dawood University of Engineering and Technology,<br>Karachi.                                      | Secretary |

2. The final meeting started with recitation from the Holy Quran by Engr. Imtiaz Ali. Ms. Syeda Sanober Rizvi, Deputy Director (Curriculum), Coordinator HEC, welcomed the participants and briefed them about the purposes of preliminary meeting of NCRC. She informed the participants about the aim and objectives of the



meeting with focus on revising the course outlines of BE/BS (4-year) and ME/MS Petroleum and Gas Engineering to make it compatible with international standards and demands as well as ensuring the uniformity of academic standard within the country.

3. In the preliminary meeting, Prof. Dr. Abid Murtaza Khan (NEDUET, Karachi) was elected as Convener of NCRC, whilst Engr. Prof. Dr. Abdul Haque Tunio (MUET, Jamshoro) was elected as Co-convener. Engr. Faisal Ur Rahman Awan (DUET, Karachi) was unanimously elected as Secretary of NCRC.
4. The Coordinator then requested the Convener to conduct proceedings of all technical sessions of meeting for three days.
5. On the request of the Convener, all the members gave their perspective on the implementation of BE/BS (4-year) and ME/MS program in their respective universities / institutions. For critical review of undergraduate program and development of course outline assignments, individual/ sub-groups were formulated.
6. During the proceedings of the meeting the committee also considered the inputs given by relevant industry members and expatriate Pakistani in drafting the curriculum and incorporated their valuable suggestions where necessary. The recommendations of both programs as presented by respective individuals/sub-groups were reviewed and agreed by the members. The Committee during its deliberations that spread over three days (January 25-27, 2017) in the preliminary meeting and three days of final meeting (May 15-17, 2017) and covered six (06) technical sessions, achieved the following objectives:
  - i) Finalized the final draft of the curriculum in the discipline of Petroleum and Gas Engineering to bring it at par with international standards.
  - ii) Incorporated latest reading and writing material against each course.
  - iii) Brought uniformity and developed minimum baseline courses in each and every course of study of BE/BS program.
  - iv) Brought the curriculum at par with the latest guidelines regarding Outcome Based Education (OBE) of Pakistan Engineering Council.
  - v) Made recommendations for promotion/development of the discipline.
7. After the prolonged deliberations, the Committee unanimously approved the draft curriculum of BE/BS (4-year) and ME/MS Petroleum and Gas Engineering. The Convener of the Committee

thanked all members of the Committee for sparing their precious time and valuable contributions made towards preparation of the draft curriculum.

8. The Committee acknowledged the Higher Education Commission for providing the opportunity to contribute in this assignment of national interest. It thanked the administration of HEC regional centers at Karachi & Lahore for their facilitation during the meetings and also thanked the representative of HEC Ms. Syeda Sanobar Rizvi, Deputy Director (Curriculum), for her valuable guidance in the start and completion of this document.
9. The meeting ended with the vote of thanks to the Chair as well as participants of the meeting.

## **VISION AND MISSION**

### **VISION**

To educate and equip the students with tools for exploitation of hydrocarbon resources in the most viable and economical manner by using fundamental principles as well as state-of-the-art technology.

### **MISSION**

The mission is to produce qualified and well-versed Petroleum Engineers equipped with fundamental sciences, able to find viable solutions, and skills to enter executive technical positions in industry, R&D institutes, public sector organizations and academia.

### **RATIONALE / SCOPE**

A key source of energy is oil and natural gas. Efficient recovery of these resources requires Petroleum Engineers with a sound knowledge of fundamentals and latest technological developments relevant to this field. The mission of the Petroleum Engineering education is to produce graduates who can not only satisfy the current needs of the country's petroleum industry, but are also able to develop technologies indigenously. Preparing effective and efficient professionals through research and to develop the methods to utilize all the available natural resources in order to fulfill the energy needs of Pakistan in coming years. This will contribute in socio- economic development of Pakistan and the region.

### **PROGRAM OBJECTIVES**

The program emphasizes on building strong base in Petroleum Engineering discipline and detailed understanding of core areas with practical knowledge that comprehends with use of professional software and laboratory practices. The program is competent to enhance capabilities for higher education and to fulfill the requirements of the petroleum industry. It is also oriented towards the Outcome Based Education (OBE). The main objectives are to develop:

- i) Understanding and comprehension of regional energy resources and the future trends for the welfare of the society.
- ii) Critical thinking in the graduates so that they can identify and solve new problems.
- iii) Effective communication skills and ability to work independently as well in team.
- iv) Professionalism, ethical values and determination among graduates to continue life-long learning.

## PROGRAM LEARNING OUTCOMES

The program has been designed to demonstrate that by the time of graduation, the students have attained a certain set of knowledge, skills and behavioral traits, at least to some acceptable minimum level. Specifically, it demonstrates that the graduates have acquired the following anticipated Program Learning Outcomes (PLO's):

1. **Engineering Knowledge:** An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/Development of Solutions:** An ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4. **Investigation:** An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
5. **Modern Tool Usage:** An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.
6. **The Engineer and Society:** An ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.
7. **Environment and Sustainability:** An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
9. **Individual and Team Work:** An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.
10. **Communication:** An ability to communicate effectively, orally as well as in writing, on complex engineering activities with the

engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management:** An ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.
12. **Lifelong Learning:** An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

## **COURSE LEARNING OUTCOMES**

To achieve the above PLO's each course has been designed with course learning outcomes (CLO's) according to Bloom's taxonomy. Studying any course, the learners will be able to:

1. Define and describe the terms.
2. Understand the basic principles, elements and types.
3. Discuss
4. Apply
5. Compare
6. Evaluate

### **TEACHING METHODS**

For making the program more competitive, specific teaching methods and assessments are described. These include the following:

1. Teaching large groups (lectures)
2. Flipped classroom
3. Active learning
4. Problem based learning
5. Work based learning
6. Blended learning
7. Student-led learning

### **ASSESSMENT (FORMATIVE/SUMMATIVE)**

1. Weightage of theory and practicum:  
Weightage of theory and practicum is mentioned in course scheme.
2. Weightage of Summative (Mid Semester) and Formative Assessment (Final Semester)  
Summative Assessment: Each Mid Examination of Theory Papers shall carry a minimum standard set / observed by the respective degree awarding institute / university.  
Formative Assessment: Each Final Examination of Theory Papers shall carry a minimum 50% of total marks assigned to a course in Semester System.  
Similarly, each final examination of practical work shall carry minimum of 60% marks for viva voce.
3. Weightage and format of e-test and written test (MCQs, Short Questions, Long Questions etc.)  
As decided by the University policy.
4. List of Activities like discussion, quiz, speech, presentation, assignments, portfolios, society visits, case studies, projects, etc.

## **INTAKE / ADMISSION CRITERIA**

The intake / admission criteria for B.E. / B.S. Petroleum Engineering shall follow National Qualification Framework of Pakistan 2015 and Pakistan Engineering Council Regulations for Engineering Education in Pakistan, Article 2, which is reproduced as under: -

### **ARTICLE 2:**

#### **Minimum Qualification for Admission to Engineering Bachelor's Degree Programmes Offered by Engineering Institutions and Universities**

A candidate seeking admission in an Engineering Institution/University for working towards Bachelor's Degree in any recognized branch of Engineering must fulfill the following minimum requirements: —

- (a) (i) He or she has passed the Higher Secondary School Certificate (HSC/HSSC) Pre-Engineering Examination with Physics, Chemistry and Mathematics, securing at least 60% marks in aggregate of a University, a Board of Intermediate or Board of Intermediate and Secondary Education in Pakistan. In addition, a combination of Physics, Mathematics and Computer Studies/Computer Science may be allowed for admissions in all Computer related Engineering Programmes, Electronics, Telecommunications and Avionics Engineering Programmes and a combination of Biology, Physics, Chemistry may also be allowed for Bio-Medical or Bio-Engineering: Provided that any candidate who has been admitted in an Engineering Institution or University for working towards Bachelor's degree in any recognized branch of engineering before the 6th June, 2003, and does not fulfill the above specified minimum requirements for such admission, shall be considered for registration by the Pakistan Engineering Council. OR
- (ii) He or she has passed any other examination of a Foreign University/Institution/Examination Body, with both standard as well as scope wise is equivalent to the Higher Secondary School Certificate (Pre-Engineering) of a University or a Board of Intermediate/Intermediate and Secondary Education in Pakistan. Equivalence of the Examination passed by the candidate shall be determined by the concerned University.
- (b) He or she has passed an entrance test conducted by the respective Institution or University.
- (c) (i) A candidate who has passed the Diploma of Associate Engineer (DAE) Examination, securing at least 60% aggregate marks shall be eligible for applying in admission against reserved seats in relevant discipline of Engineering in which he or she has passed the DAE examination; and the

- relevancy of DAE will be as determined by Accreditation Committee of this Council; and
- (ii) A candidate possessing B.Tech (Hons)/B.Sc. Engineering Technology or equivalent qualification duly recognized by HEC seeking admission towards the relevant engineering discipline against 02% reserved seats of B.Tech (Hons)/B.Sc. Engineering Technology, shall be considered for admission in 2015 and after, with one year of exemption: Provided that the candidate possessing B.Tech (Pass), B.Tech (Hons) qualification recognized by HEC enrolled/ graduated upto 31st December, 2014 in relevant engineering discipline against reserved seats, with one year and two year of exemption respectively, shall be considered for registration with the Council.
  - (d) A candidate seeking admission should possess adequate mental and physical health to be able to obtain engineering education as prescribed and necessary steps should be taken by University/ Institution to ensure this provision on admission of students.

The intake / admission criteria for M.E. / MS Petroleum Engineering shall follow National Qualification Framework of Pakistan 2015 and Minimum Criteria for Admission in MS/M.Phil Programmes of HEC which is reproduced as under: -

- (a) Sixteen years of schooling or 4 year education (124 credit hours) after HSSC/F.A. /F.Sc/Grade 12 equivalent will be required for admission in the M.Phil/MS.
- (b) The GAT-General ([www.nts.org.pk/gat/gat.asp](http://www.nts.org.pk/gat/gat.asp)) conducted by the National Testing Service with a minimum 50% cumulative score will be required at the time of admission to M.Phil/M.S. The GAT-General test is valid for a period of two years.
- (c) For award of M.Phil/M.S/Equivalent degree, candidates will either need to complete 30 credit hours of course work or complete 24 credit hours of course work along with a minimum of 6 credit hours for research work/thesis.
- (d) There should be at least 2 relevant full time Ph.D. Faculty members in a department to launch the M.Phil/MS/MBA programmes.



## FRAMEWORK FOR B.E. / B.SC. PETROLEUM/ PETROLEUM & NATURAL GAS ENGINEERING.

Based on HEC existing Scheme of Studies for Bachelor of Petroleum Engineering/Petroleum & Natural Gas Engineering, a critical review in line with emerging trends, future developments and strengthening of knowledge in respect to industry requirements was carried out in line with similar programs of international repute. The review includes changes in course contents, deletion and addition of new courses, considerations of pre-requisite courses and changes in scheme of studies.

A proposed revised Scheme of Studies for B.E. / B.Sc. Petroleum Engineering/Petroleum Natural Gas Engineering is recommended as under. (Table 1.1-1.3)

**Table 1.1:** Summary of Proposed Revised Scheme of Studies for B.E. / B.Sc. Petroleum Engineering/Petroleum & Natural Gas Engineering

Total number of courses	43
Total number of credit hours	136
Number of credit hours per semester	16 - 18
Engineering Proportion	65 – 70 %
Non-Engineering Proportion	30 – 35 %

**Table 1.2:** Summary of Domains and Knowledge Areas in Proposed Revised Scheme of Studies for B.E. / B.Sc. Petroleum Engineering/Petroleum & Natural Gas Engineering.

Domain	Knowledge Area	Total Courses	Total Credit Hours	Overall %
Non-Engineering	Humanities	6	14	30.88%
	Management Sciences	2	06	
	Natural Sciences	7	22	
	<b>Sub Total</b>	<b>15</b>	<b>42</b>	
Engineering	Computing	2	6	69.12%
	Engineering Foundation	7	17	
	Major Based Core (Breadth)	6	23	
	Major Based Core (Depth)	7	27	

	Inter-Disciplinary Engineering Breadth	5	15	
	Petroleum Engineering Project	1	06	
	<b>Sub Total</b>	<b>28</b>	<b>94</b>	
Total		<b>43</b>	<b>136</b>	100.00

**Table.1.3** Knowledge, Areas, Sub-Areas, Courses and Credit Hours in Proposed Recommended Scheme of Studies for B.E. / B.Sc. Petroleum Engineering / Petroleum & Natural Gas Engineering

<b>(Non-Engineering Domain)</b>									
Knowledge Area	Sub Area	Name of Course	Lec CH	Lab CH	CR	Total Courses	Total Credits	% Area	%Overall
Humanities	English	English-I: Functional English	2	0	7	3	7	16.67	5.15
		English-II: Communication Skills	2	1					
		English-III: Technical Writing and Presentation Skills	2	0					
	Culture	Pakistan Studies	2	0	4	2	4	9.52	2.94
		Islamic Studies / Ethics	2	0					
Social Sciences	Social Sciences	3	0	3	1	3	7.14	2.20	
Natural Sciences	Maths	Mathematics-I: Calculus	3	0	9	3	9	21.43	6.62
		Mathematics-II: Differential Equation	3	0					
		Mathematics-III: Complex Variables and Linear Transform	3	0					
	Physics	Applied Physics	3	1	4	1	4	9.52	2.94
	Compulsory	Applied Geology	2	1	1	3	9	21.43	6.62
		Applied Chemistry	2	1					
Electives*	Elective-I:	3	0	8					

	(1 out of 4 to be opted)	Principles of Corrosion Control							
		Elective-II: Probability and Statistics	3	0					
		Elective-III: Surveying & Levelling	2	1					
		Elective-IV: Unconventional Reservoir	3	0					
Management Sciences		Project Planning and Management	2	1	6	2	6	14.29	4.41
		Environment and Safety Management	3	0					
TOTAL			45	6	5 1	15	42	100	30.88
TOTAL (Weight)	MAXIMUM		37	5	4 2	15	42	100	
TOTAL (Weight)	MINIMUM		36	6	4 2	15	42	100	
Standard (PEC)							41 – 47	100	30% - 35%
Standard (HEC)							44 – 47	100	33% - 35%
* Depends upon availability of teacher/ university policy.									

<b>(Engineering Domain)</b>									
Knowledge Area	Sub Area	Name of Course	Lec CH	Lab CH	CR	Total Courses	Total Credits	%Area	%Over all
Computing	Programming	Computer Programming and Application Software	2	1	6	2	6	6.38	4.41
	Design	Applied Numerical Methods	2	1					
Engineering Foundation		Fluid Mechanics	2	1	17	7	17	18.09	12.50
		Fundamentals of Petroleum Engineering	2	0					
		Principles of Electrical Engineering	2	1					
		Engineering Drawing	0	2					
		Workshop Practice	0	2					
		Mechanics of Materials	2	1					
		Petroleum Economics	2	0					
Major Based Core (Breadth)		Petrophysics	3	1	23	6	23	24.47	16.91
		Well Logging	2	1					
		Properties of Reservoir Fluids	3	1					
		Reservoir Engineering - I	3	1					
		Petroleum Production Engineering-I	3	1					

		Drilling Engineering-I	3	1					
Major Based Core (Depth)		Principles of Enhanced Oil Recovery	3	1	27	7	27	28.72	19.86
		Well Testing	3	1					
		Reservoir Engineering - II	3	1					
		Reservoir Simulation	3	1					
		Natural Gas Engineering	2	1					
		Petroleum Production Engineering-II	3	1					
		Drilling Engineering-II	3	1					
Inter-Disciplinary Engineering Breadth (Electives)		Instrumentation and Process Control	2	1	15	5	15	15.96	11.03
		Applied Thermodynamics	2	1					
		Petroleum Geology and Geophysical Exploration	3	0					
		Reservoir Geo-Mechanics	2	0					
		Petroleum Refinery Engineering	3	1					
Senior Design Project		Final Year Project	0	6	6	1	6	6.38	4.41
TOTAL			63	31	94	28	94	100	69.12
TOTAL (Weight)	MAXIMUM		63	31	94	28	94	100	69.12

TOTAL (Weight)	MINI- MUM		63	31	94	28	94	100	69.12
Standard (PEC)							89-95	100	65-70%
Standard (HEC)							89-95	100	65-70%

## Scheme of Studies for BE/BSc Petroleum Engineering

### Semester-I

Sr. No.	Course Code	Course Title	Lec CH	Lab CH	Total CH
1.	PET-101	Fundamentals of Petroleum Engineering	2	0	2
2.	GEO-107	Applied Geology	2	1	3
3.	HU-102/ HU-103	Islamic Studies / Ethics	2	0	2
4.	MA-104	Calculus	3	0	3
5.	PHY-103	Applied Physics	3	1	4
6.	HU-101	Functional English	2	0	2
7.	WS-105	Workshop Practice	0	2	2
<b>Total</b>			<b>14</b>	<b>4</b>	<b>18</b>

### Semester-II

Sr. No.	Course Code	Course Title	Lec CH	Lab CH	Total CH
1.	HU-111	Communication Skills	2	1	3
2.	HU-106	Pakistan Studies	2	0	2
3.	MA-109	Differential Equation	3	0	3
4.	CH-108	Applied Chemistry	2	1	3
5.	ME-110	Engineering Drawing	0	2	2
6.	CS-113	Computer Programming and Application Software	2	1	3
<b>Total</b>			<b>11</b>	<b>5</b>	<b>16</b>

### Semester-III

Sr. No.	Course Code	Course Title	Lec CH	Lab CH	Total CH
1.	HU-217	Technical Writing and Presentation Skills	2	0	2
2.	MA-215	Complex Variables and Linear Transform	3	0	3
3.	CE-216	Fluid Mechanics	2	1	3
4.	EE-214	Principles of Electrical Engineering	2	1	3
5.	PG-203	Petroleum Geology and Geophysical Exploration	3	0	3
6.	CH-218	Applied Thermodynamics	2	1	3
<b>Total</b>			<b>14</b>	<b>3</b>	<b>17</b>



**Semester-IV**

Sr. No.	Course Code	Course Title	Lec CH	Lab CH	Total CH
1.	PET-211/ PET-212/ MA-218/ CE-205	Principles of Corrosion Control (3+0) / Unconventional Reservoirs (3+0) / Probability and Statistics (3+0) / Surveying & Levelling (2+1)	3/2	0/1	3
2.	CE-220	Mechanics of Materials	2	1	3
3.	PG-202	Drilling Engineering-I	3	1	4
4.	PG-204	Petrophysics	3	1	4
5.	HU-222	Social Sciences	3	0	3
<b>Total</b>			<b>14/13</b>	<b>3/4</b>	<b>17</b>

**Semester-V**

Sr. No.	Course Code	Course Title	Lec CH	Lab CH	Total CH
1.	CS-321	Applied Numerical Methods	2	1	3
2.	PG-305	Properties of Reservoir Fluids	3	1	4
3.	PG-306	Drilling Engineering-II	3	1	4
4.	MAN-323	Environment and Safety Management	3	0	3
5.	CH-325	Instrumentation and Process Control	2	1	3
<b>Total</b>			<b>13</b>	<b>4</b>	<b>17</b>

**Semester-VI**

Sr. No.	Course Code	Course Title	Lec CH	Lab CH	Total CH
1.	PG-311	Reservoir Geomechanics	2	0	2
2.	PG-307	Well Logging	2	1	3
3.	PG-308	Reservoir Engineering – I	3	1	4
4.	PG-309	Petroleum Production Engineering-I	3	1	4
5.	CH-326	Petroleum Refinery Engineering	3	1	4
<b>Total</b>			<b>13</b>	<b>4</b>	<b>17</b>

**Semester-VII**

Sr. No.	Course Code	Course Title	Lec CH	Lab CH	Total CH
1.	PG-410	Natural Gas Engineering	2	1	3
2.	MAN-424	Project Planning and Management	2	1	3
3.	PG-411	Well Testing	3	1	4
4.	PG-412	Petroleum Production Engineering-II	3	1	4
5.	PG-416	Reservoir Simulation	3	1	4
6.	PG-414	Final Year Project*	0	0	0
<b>Total</b>			<b>13</b>	<b>5</b>	<b>18</b>

**Semester-VIII**

Sr. No.	Course Code	Course Title	Lec CH	Lab CH	Total CH
1.	PG-414	Final Year Project	0	6	6
2.	PG-417	Petroleum Economics	2	0	2
3.	PG-415	Principles of Enhanced Oil Recovery	3	1	4
4.	PG-413	Reservoir Engineering – II	3	1	4
<b>Total</b>			<b>8</b>	<b>8</b>	<b>16</b>
<b>Grand Total</b>			<b>100/99</b>	<b>36/37</b>	<b>136</b>

\* The total six (6) credits are distributed evenly in 7<sup>th</sup> and 8<sup>th</sup> semester, but the credit will be accounted in 8<sup>th</sup> Semester only.

## DETAIL OF EACH COURSE FOR B.E. / B.Sc. PETROLEUM ENGINEERING

### SEMESTER-I

<b>Course code:</b>	PET-101
<b>Course title:</b>	Fundamentals of Petroleum Engineering
<b>Credit hours:</b>	2+0
<b>Prerequisite:</b>	Pre-Engineering or Equivalent

#### **Specific Objectives of Course:**

To familiarize the students with the basics of Petroleum Engineering and the portfolio of national and international petroleum industry.

#### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Describe the role of the petroleum engineer, and the skill set that is required to function in this role.
2. Acquire knowledge about the oil field vocabulary, history and demonstrate familiarity with various field operations and techniques used in reservoir, drilling, and production engineering.
3. Define the methods for the calculation and measurement of rock and fluid properties.
4. Learn about major issues and technology advancement in petroleum engineering.
5. Function in multi-disciplinary teams through teamwork assignments.
6. Develop understanding of professional and ethical responsibility.

#### **Content List**

1. Introduction to Energy
  - a. Sources of energy
  - b. National and international energy requirements
  - c. Contribution of petroleum in global energy requirements.
2. History of Petroleum
  - a. History of the petroleum industry and its influence on geopolitics.
3. Introduction to Petroleum
  - a. Petroleum engineering: Definition, scope and responsibilities of Petroleum Engineer
  - b. Petroleum industry: Highlights of national and international petroleum industry
  - c. Overview of Petroleum Engineering including geological, geochemical and geophysical prospecting.
  - d. Origin, discovery, development and prospects of Hydrocarbons.

- e. Petroleum play.
- f. Distribution of petroleum resources on local and international level.
- g. Important units.
- 4. Reservoir
  - a. Reservoir Engineering
  - b. Reservoir rock and flow properties.
  - c. Formation evaluation.
- 5. Drilling
  - a. Drilling Engineering
  - b. Introduction to drilling operations: The onshore and offshore operations.
  - c. The rig functions, well planning, bits, drilling fluid and casing accessories.
- 6. Production
  - a. Production Engineering, Processing, transportation and refining
  - b. Introduction to production, processing and transportation.
  - c. Well completion.
  - d. Flow in pipes and surface production facilities.
  - e. Production forecasting, reserve categories.
  - f. Environmental concerns.
  - g. Corrosion and its control.
- 7. Overview of Unconventional hydrocarbon resources.

#### **Practicum**

NIL

#### **Bibliography/References**

1. Books:
  - a. Debby Denehy, "Fundamentals of Petroleum", 5th Edition, PETEX, 2011.
  - b. Kate Van Dyke," Fundamentals of Petroleum", 5th Edition, Petroleum Extension Service (Petex), 2011.
  - c. Ma and Holditch, "Unconventional Oil and Gas Resources Handbook: Evaluation and Development", 1st Edition, Elsevier, 2015
  - d. Usman Ahmed and Nathan Meehan; "Unconventional Oil and Gas Resources, Exploitation and Development", CRC Press, 2016
2. Journals/Periodicals:
  - a. Journal of Petroleum Technology.
  - b. Oil and Gas Journal
3. World Wide Web:
  - a. [www.spe.org](http://www.spe.org)
  - b. [www.onepetro.org](http://www.onepetro.org)

<b>Course code:</b>	GEO-107
<b>Course title:</b>	Applied Geology
<b>Credit hours:</b>	2+1
<b>Prerequisite:</b>	Pre-Engineering or Equivalent

**Specific Objectives of Course:**

To teach the students about the basic geological concepts.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Acquire knowledge about earth its history and the geological processes.
2. Understand the role of geology in the Petroleum Exploration.
3. Recognize and interpret geological structures and its impact on the development of petroleum systems.
4. Identify minerals and rocks and to classify rocks types.
5. Assess sedimentary rocks potential as source, reservoir or seal rock.
6. Read and interpret different geological maps.
7. Solve geological problems using scientific techniques.

**Content List**

1. Introduction to various branches of geology
2. Origin of earth and its place in universe
3. Interior of the earth and chemical composition of the earth's crust
4. Mountain building and valley formation
5. Drainage pattern and their types
6. Agents of weathering and erosion
7. Concepts of geological time and its scale.
8. Correlation techniques, isostasy and continental drift.
9. Theories of plate tectonics
10. Earth quakes and volcanism
11. Formation of rocks; sedimentary, igneous and metamorphic and minerals
12. Primary and secondary structures of sedimentary rocks
13. Determination of dip, strike, and thickness of beds.
14. Completion of outcrops and construction of cross sections.
15. Occurrence of mineral deposits in Pakistan.

**Practicum**

1. Introduction of Minerals and Rocks.
2. Study of Moh's scale of hardness and identification of its minerals.
3. Study and identification of igneous rocks.

4. Study and identification of metamorphic rocks.
5. Study and identification of sedimentary rocks.
6. To study the different parts of Brunton Compass.
7. To measure the dip and strike of an inclined plane with the help of Brunton Compass.
8. To draw the cross-section of a contour map and show the drainage pattern of the area.
9. To determine the true dip value by the help of two apparent dips.
10. Three-point problem for measuring dip and strike if three outcrop are located on a contour map.
11. To calculate the thickness of beds.
12. To study various features on a Geological map.

### **Bibliography/References**

1. Books:
  - a. Long, L. E., "GEOLOGY:" 14th edition, McGraw-Hill, New York, 2009.
  - b. F. G. H. Blyth, M. H. De Freitas, "Geology For Engineers", Elsevier - Amsterdam, 1984
  - c. K. M. Bangar, "Principles of Engineering Geology", Standard Publishers Distributors, 1995, New Delhi
  - d. M. P. Billings, "Structural Geology", Prentice-Hall India, 1974, New Delhi
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

**Course code:** HU-102  
**Course title:** Islamic Studies  
**Credit hours:** 2+0  
**Prerequisite:** Pre-Engineering or Equivalent

### **Specific Objectives of Course:**

To instill Islamic ideology and ethics in students.

### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Enhance the religious knowledge in more informative and comprehensive manner.
2. Create interest towards Sharia, Quran & Hadith.
3. Acquire knowledge in character building, developing Islamic approach & thinking, and developing the habit of finding solutions of daily life problems through Quran and Sunnah.

4. Learn Biography of the Holy Prophet (PBUH) highlighting his status as a guide to mankind.
5. Understand Islamic civilization and a brief history of its impacts on world.
6. Acquire knowledge about the achievements of Muslim scholars and scientists.

### **Content List**

1. Al-Quran-ul-Karim:
  - a. Significance of the Holy Quran, Compilation of the Holy Quran, Ijaz-ul-Quran.
  - b. Textual Study of Surah Al-Hujurat (Complete), (Translation and Explanation: Manners of meeting with the Holy Prophet; Brotherhood; Equality; Backbiting; Blame and foolery)
  - c. Textual Study of Surah Al-Maidah (Verses 1-26), (Translation and Explanation: Commands of Halal and Haram; The importance of cleanliness in Islam; The relations between Muslims and Ahl-e-Kitab; Attitude of Ahl-e-Kitab towards Muslims)
  - d. Textual Study of Surah Al-Furqan (Verses 63-77), (Translation and Explanation: Characteristics of Ibad-ur-Rehman)
  - e. Textual Study of Holy Quran: Surah Luqman (Complete), Translation and Explanation: Lahv-o-La'ab; Azmat-e-Quran; Taskheer of the Universe;
  - f. Disobedience of parents is forbidden; To see the parents with love is as Hajj; Intense care of parents in old life; Treatment and behavior with parents; Amr Bil Maruf-o-Nahi An'il Munkar; Need and importance of preaching (Dawat-din); Methods of preaching; Characteristics of a preacher.

Note: Teacher may select any number of Surah as per his discretion.

2. Al-Hadith Al-Sharif
  - a. The need and importance of Hadith
  - b. An introductory note about compilation of Hadith
  - c. A brief introduction of Sihah Sittah and their compilers
  - d. Balugh-ul-Maram
  - e. Kitab-ul-Jami: Bab-ul-Adab; Bab-ul-Bir Wa Salah
  - f. Rights of individuals in Islam
  - g. Relations with the relatives.
  - h. Textual Study of Ahadith (Arba'een-e-Nava'vi: 1-21 Translation and Explanation).
3. Deen-e-Islam:
  - a. The Study of Cardinals/Articles of Faith: Touheed, Fundamentals of Touheed, Types of Touheed, Prophet-hood and finality of Prophet-hood, The day of judgment.

- b. Pillars of Islam: Prayer: Imposition of Prayer; Orders; Shariah's point of view; Significance; Fasting: Meaning of fasting; Obligation of fasting; Significance; Disbursement; Physical and spiritual advantages; Zakat: The economic system of Islam; Importance of Zakat; Prohibition of (Riba) Sood; Comparison between Islamic economic system and Socialism, Capitalism and Communism; Hajj: Imposition of Hajj; Commands and rites of Hajj; Financial, Social, Spiritual advantages of Hajj; Jihad: Importance and significance; Necessity of Jihad in modern age; Kinds of Jihad.
- 4. Seerat-un-Nabi
  - a. Life of the Holy Prophet (S. A. W. W): From Prophet-hood to Hijrah, at Madina
  - b. Madina Pact
  - c. Holy Prophet as a complete person; Mohammedan Revolution.
- 5. Islam and Modern Science
  - a. Quran as a guide for the modern scientific development: Surah Al-Baqarah: 164; Surah Aal-e- Imran: 190-191; Importance of science education in the modern age; Introduction of Muslim scientists; Contribution of Muslim scholars towards development of science.
- 6. Principles of Tafseer
  - a. Haddoo-o-Tazirat: Rape; Qadaf; Liaan; Ifk; Privacy and Hijab – Al-Baqarah: 178 – 179; Al- Nisa: 92 – 93; Al-Maidah: 8, 31 – 34, 38; Al-Noor: 2 – 6, 27 – 29, 31 – 60; Al-Ahzab: 32 – 33, 53, 55, 59.
- 7. Ethics
  - a. Ethics and Religion: Ethical behavior of the Prophet; Impact of belief on ethics; Concept of worship and manners / social relation in religion and their impact on ethics
  - b. Ethics and character building significance of moral values: Charity; Tolerance; Simplicity; Respect of mankind; Social etiquettes; Etiquettes of meeting; Etiquettes of eating and drinking; Etiquettes of conversation; Rights of people
  - c. Verses of the Holy Quran about ethics: Aal-e-Imran: 112; Al-Nisa: 43, 90 – 91; Al-Aaraf: 35; Al-Ra'ad: 30; Al-Nahal: 90 – 91; Bani Israil: 29 – 37; Al-Fatah: 26;
  - d. Moral values in the light of Hadith: Bab-ul-Zuhad wal Wara: Ahadith 2, 6; Bab-ul-Tarheeb Min Masavi Al-Akhlaq: Ahadith 1, 6, 9.

**Practicum**  
NIL



## **Bibliography/References**

1. Books:
    - a. M. D. Zafar, "A Textbook Of Islamic Education", Aziz Book Depot - Lahore, 2001
    - b. Hameed ullah Muhammad, "Emergence of Islam", IRI, Islamabad
    - c. Hameed ullah Muhammad, "Muslim Conduct of State", IRI, Islamabad
    - d. Hameed ullah Muhammad, "Introduction to Islam", IRI, Islamabad
    - e. Mulana Muhammad Yousaf Islahi, Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law", leaf Publication Islamabad, Pakistan.
    - f. Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
    - g. Mir Waliullah, "Muslim Jurisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
    - h. H. S. Bhatia, "Studies in Islamic Law, Religion and Society", Deep and Deep Publications New Delhi (1989)
    - i. Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)
  2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL
- 

<b>Course code:</b>	HU-103
<b>Course title:</b>	Ethics
<b>Credit hours:</b>	2+0
<b>Prerequisite:</b>	Pre-Engineering or Equivalent

### **Specific Objectives of Course:**

To instill ethical values in students.

### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Identify the position of a professional group and its members toward society and other groups and their concern.
2. Develop Understanding of professional/ethical responsibility.
3. Elaborate the personal moral features of a specialist that provides the highest level of his/her professional duty performance.
4. Discuss the relationships with in professional groups and special professional moral standards expressing these relationships
5. Differentiate between various ethics types and ethical philosophies.

6. Apply Ethical values in their personal and professional lives.

#### **Content List**

1. Introduction to ethics, need and nature
2. Understanding ethics
3. Ethics as a sub-discipline of philosophy
4. What are moral principles
5. What are ethics in contrast to morals
6. Ethics in semantics anti-Semitic religion.
7. Ethics and responsibility
8. Justice and administrative ethics
9. Professional values and ethics
10. The significance of morality and ethics for public managers
11. Ethical decision making and the public managers
12. Internal and external pressures to violates morality and ethics
13. Building a personal code of ethics.
14. Sources of ethics in Pakistan society.
15. Professional Ethics, Administrative Ethics, Media Ethics, Legal Ethics, Research Ethics etc.
16. Ethics and Religion: Ethical behavior of the Prophet; Impact of belief on ethics; Concept of worship and manners / social relation in religion and their impact on ethics
17. Ethics and character building significance of moral values: Charity; Tolerance; Simplicity; Respect of mankind; Social etiquettes; Etiquettes of meeting; Etiquettes of eating and drinking; Etiquettes of conversation; Rights of people

#### **Practicum**

NIL

#### **Bibliography/References**

1. Books:
  - a. Jacques P.Thiroux, "Ethics, Theory and Practice", Macmillan Publishing Company, New York.
  - b. Wallace Marc J., Fay Charles H., "Compensation Theory and Practice", Boston: Kent Publishing Company, 1983.
  - c. Arvey, Richard, Faley and Robert, "Fairness in Selecting Employees", 2<sup>nd</sup> Edition, Reading-Addison-Wesley Publisher, 1988.
2. Journals/Periodicals:

NIL
3. World Wide Web:

NIL

**Course code:** MA-104  
**Course title:** Calculus  
**Credit hours:** 3+0  
**Prerequisite:** Pre-Engineering or Equivalent

**Specific Objectives of Course:**

To learn principles of mathematics and its application to engineering.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Develop understanding of basic calculus used in engineering.
2. Understand the importance and major problems of differential and integral calculus.
3. Use calculus to solve important practical problems in an optimal way with different techniques.
4. Develop solid foundation for subsequent courses in mathematics and in petroleum engineering as well as direct application to real life/field problems.

**Content List**

1. Complex Numbers and Hyperbolic Functions
  - a. Basic concepts
  - b. Argand diagram
  - c. Exponential and Polar forms
  - d. De Moivre's theorem
  - e. Roots of complex numbers Hyperbolic and inverse hyperbolic functions.
  - f. Matrices and Determinants.
2. Algebra of matrices
  - a. Inverse of a Matrix Determinants
  - b. Properties of determinants Solution of systems of linear equations
  - c. Eigenvalues and Eigenvectors.
3. Differentiation and its applications
  - a. Velocity and acceleration
  - b. Tangents and normal
  - c. McLaurin's and Taylor's series
  - d. Maxima and Minima of a function of one variable
  - e. Curvature and radius of curvature.
4. Integration and Its Application
  - a. Methods for evaluating indefinite integrals
  - b. Definite integrals
  - c. Simple Properties of definite integrals
  - d. Plan Areas
  - e. Length of an arc
  - f. Surface area and volumes of solids of revolution

- g. Moments and Centroids of plan areas
  - h. Moment of inertia of plane areas
  - i. Theorem of Pappus.
5. Partial Differentiation
- a. Function of two or more variables
  - b. Partial derivative
  - c. higher order partial derivatives
  - d. Total differentials and their applications of small errors
  - e. Differential of implicit functions
  - f. Chain rules
  - g. Maxima and Minima of a function of two variables
  - h. Taylor's and Maclaurin's series for a function of two variables.
6. Ordinary Differential Equations
- a. Basic concepts
  - b. Formulation of differential equations
  - c. first order differential equations
  - d. Second and higher order differential equations with constant coefficients,
  - e. systems of ordinary differential equations
  - f. Application to the relevant Engineering Problems.
7. Vector Algebra with Applications
- a. Scalars and Vectors
  - b. vector algebra
  - c. Scalar and Vector products
  - d. Triple products
  - e. Vector products
  - f. Vector functions
  - g. differentiation and integration of vector
  - h. application to line, plane and sphere
  - i. Polar Coordinates and Polar curves.

### **Practicum**

NIL

### **Bibliography/References**

1. Books:
- a. B. S. Grewal, "Higher Engineering Mathematics", 40th Edition, Khanna Publishers, 2007.
  - b. Wilfred Kaplan, "Advanced Calculus", Addison-Wesley-Reading, Massachusetts, 1973
  - c. Monty J. Strauss, Gerald L. Bradley, Karl J. Smith, "Calculus", 3<sup>rd</sup> Edition, Prentice Hall, 2002
  - d. Erwin Kreyszig, "Advanced Engineering Mathematics", ISBN: 9780470458365
  - e. Thomas and Finney, "Calculus with Analytic Geometry", ISBN: 9780201531749

2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL
- 

**Course code:** PHY-103  
**Course title:** Applied Physics  
**Credit hours:** 3+1  
**Prerequisite:** Pre-Engineering or Equivalent

**Specific Objectives of Course:**

To learn principles of physics and its application to engineering.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Possess sufficient knowledge of fundamental concepts in classical and modern Applied Physics.
2. Understand the laws and concepts of Applied Physics and to solve the problems and to interpret the results.
3. Develop and analyze the mathematical models of Applied Physics.
4. Conducting lab experiments and to use laboratory work bench equipment.
5. Understand interfacing Physics and Engineering to create better infrastructure for the society.

**Content List**

1. Electricity
  - a. Electric field and electrical forces,
  - b. Electric field calculations,
  - c. Gauss's Law,
  - d. Applications of Gauss's Law,
  - e. Charges on conductors,
  - f. Electrical Potential,
  - g. Energy,
  - h. Potential,
  - i. Calculate of Potentials,
  - j. Potential gradient,
  - k. Cathode-ray tube.
2. Magnetic Field:
  - a. Sources of Magnetic Field
  - b. Magnetic field of a moving charge
  - c. Magnetic field of a current element
  - d. Ampere's Law
  - e. Magnetic field of a long straight conductor
  - f. Force between parallel conductors

- g. Magnetic field of circular loops solenoid
  - h. Magnetism
  - i. Magnetic field and displacement current
  - j. Magnetic properties of materials.
3. Electromagnetic Induction:
- a. Induction phenomena,
  - b. Motional electromotive force
  - c. Faraday's law Induced electric fields
  - d. Lenz's Law
  - e. Eddy currents
  - f. Maxwell's equations
  - g. Electromagnetic Waves
  - h. Introduction, speed of and electromagnetic wave
  - i. Energy in electromagnetic waves
  - j. Electromagnetic Waves in matter,
  - k. Sinusoidal Waves
  - l. Standing.
4. Interference and Diffraction.
- a. Waves and Oscillations.
  - b. Sound Waves.
  - c. Resultant of simple Harmonic Motions Resonance and Beats.
  - d. Units and Measurement of Sound Waves.
  - e. Reflector, Refraction of sound.
  - f. Interference, Diffraction grating, Interference in Thin Film X-ray Diffraction of sound waves.
5. Atomic Physics:
- a. Structure of atom
  - b. Line spectra
  - c. Energy levels
  - d. Atomic spectra
  - e. The laser
  - f. Continuous spectra
  - g. X-ray production and scattering.
6. Nuclear Physics
- a. The nuclear atom, properties of nuclear.
  - b. Nuclear stability, radioactive transformations, Nuclear reactions, nuclear fission, nuclear fusion, reaction, Neutron thermalization, Radiation Detectors.
  - c. Natural radioactivity, artificial radioactivity, three distinct types of radiation's radioactive series, Laws of radioactive disintegration, decay constant.
  - d. Half period and mean constant, Interaction of rays with matter.

### **Practicum**

1. Ionization Potential of Mercury.
2. To study the state Characteristics of a transistor

3. To find the value of H by tangent galvanometer
4. To find the E/M of electron by deflection methods
5. To draw B-H curve of a given material
6. To find the velocity of sound waves in different media
7. To find the surface tension of a given liquid
8. C.R.O. demonstration.

### **Bibliography/References**

1. Books:
  - a. Robert Resnick, Kenneth S. Krane, "Physics", Volume 2, Wiley, 2001.
  - b. Raymond A. Serway, Clement J. Moses, Curt A. Moyer, "Modern Physics", 3rd Edition, Cengage Learning, 2004.
  - c. Hugh D. Young, Roger A. Freedman, Lewis Ford, "University Physics", 7<sup>th</sup> Ed., Addison Wesley,
  - d. Halliday and Resince, "Applied Physics" 5<sup>th</sup> Edition
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

<b>Course code:</b>	HU-101
<b>Course title:</b>	Functional English
<b>Credit hours:</b>	2+0
<b>Prerequisite:</b>	Pre-Engineering or Equivalent

### **Specific Objectives of Course:**

1. To recall English learning, enhance language skills and develop critical thinking.
2. To comprehend authentic text.
3. To encourage the learners to participate actively in discussion relevant to 1<sup>st</sup> year Engineering Students' level of comprehension.
4. To enhance language skills and develop critical thinking.
5. To enable students to use of language with confidence and use different components of grammar.

### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand of the basic principles and elements of English Grammar.
2. Develop capability for taking notes, fluent and effective reading, time management, organizing and taking information.
3. Boost verbal abilities which can be applied to every field of study.
4. Analyze and comment on different texts/researches.
5. Enhance formal writing and presentation skills.

6. Perform and communicate well in corporate environment.

### **Content List**

1. Basics of Grammar
  - a. Parts of speech and use of articles
  - b. Sentence structure
  - c. Active and passive voice
  - d. Practice in unified sentence
  - e. Analysis of phrase, clause and sentence structure
  - f. Transitive and intransitive verbs
  - g. Punctuation and spelling.
2. Comprehension
  - a. Answers to questions on a given text.
3. Discussion
  - a. General topics and every day conversations (topics for discussion to be at the discretion of the teacher keeping in view the level of students).
4. Listening
  - a. To be improved by showing documentaries/films carefully selected by subject teachers.
5. Translation skills
  - a. Local language to English.
  - b. Urdu to English
6. Paragraph writing
  - a. Topics to be chosen at the discretion of the teacher.
7. Presentation skills
  - a. Introduction.

### **Note:**

1. Extensive reading is required for vocabulary building.
2. Students should be encouraged to read daily newspapers and journals.

### **Practicum**

NIL

### **Bibliography/References**

1. Books:
  - a. Grammar
    - i. A.J. Thomson and A.V. Martinet, "Practical English Grammar Exercises 1", Third edition, Oxford University Press. 1997. ISBN 0194313492
    - ii. A.J. Thomson and A.V. Martinet, "Practical English Grammar Exercises 2", Third edition, Oxford University Press. 1997. ISBN 0194313506



- b. Writing
  - i. Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet, "Writing Intermediate", Oxford University Press, 1987.
  - ii. A Haley, "Oxford Supplementary Skills. Fourth Impression", Oxford University Press. 1993. ISBN 0194534057
- c. Reading/Comprehension
  - i. Brian Tomlinson and Rod Ellis, "Reading. Upper Intermediate", Oxford Supplementary Skills, Third Impression 1992. ISBN 0194534022.
  - ii. Brian Tomlinson and Rod Ellis, "Reading Advanced (Oxford Supplementary Skills)", Third Impression ISBN: 0194534030.
- 2. Journals/Periodicals:  
NIL
- 3. World Wide Web:  
NIL

**Course code:** WS-105  
**Course title:** Workshop Practice  
**Credit hours:** 0+2  
**Prerequisite:** Pre-Engineering or Equivalent

**Specific Objectives of Course:**

To provide the practical training to the students with various workshop operations.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand the functions of different hand tools and instruments used during workshop practices.
2. Design and conduct experiments as well as to analyze and interpret data to strengthen the theoretical concepts.
3. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety.
4. Function in multi-disciplinary team.

**Content List**

NIL

## Practicum

1. **Machine Shop** (Learn to operate lathe, milling, drilling, cutting, grinding and make a work piece)
  - a. Further work on the lathe including drilling from the tailstock, boring in chuck and holding work on faceplate.
  - b. Introduction and demonstration on the mill machine, methods of holding work, use of dividing head.
  - c. Form cutting of involutes gear and generation of spiral.
  - d. Study of universal tool cutter grinding machine, use of gauges.
2. **Fitting Shop** (Make a small hand tool, including marking out from blue-print, filing to size, and punching marks)
  - a. The making of a small hand tool, involving marking out from blue-print and filing to size.
  - b. Use of surface plate and surface gauge.
  - c. Measurement by micrometer or Vernier caliper.
  - d. Stripping down a small assembly to examine its needs for repair and its re-erection. Basic knowledge of limits and Fits system.
3. **Electrical Shop**
  - a. Wiring of circuit to a blue-print.
  - b. Make an electric circuit work piece
  - c. Study of wiring circuit of a mechanically propelled vehicle.
  - d. Connection of single and three phase motors, battery and its charging.
4. **Carpentry and Pattern Shop**
  - a. Introduction to pattern making practice.
  - b. Different types of pattern.
  - c. Shrinkage and other allowance.
  - d. Preparations of a pattern with core print and core box.
  - e. Wood turning practice.
  - f. Make a wooden work piece from blue-print of a given design specifications.
5. **Smithy and Foundry Shop**
  - a. Introduction and use of moulding / moulder's tools.
  - b. Preparation of a mould and a core.
  - c. Method of melting/shaping metals.
  - d. Making of a casting from a simple pattern in either ferrous or non-ferrous metal.
6. **Welding**
  - a. Fabrication exercises in electrical and gas welding.
  - b. Inspection of welding joints steel metal work.

### **Bibliography/References**

1. Books:
    - a. K.C. John, "Mechanical Workshop Practice", Second Edition, Prentice-Hall of India Pvt. Limited, 2010 ISBN: 978-81-203-4166-1
  2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL
- 

### **SEMESTER-II**

<b>Course code:</b>	HU-111
<b>Course title:</b>	Communication Skills
<b>Credit hours:</b>	2+1
<b>Prerequisite:</b>	Functional English

#### **Specific Objectives of Course:**

To enhance language skills and develop critical thinking.

#### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Comprehend technical and non-technical contents.
2. Develop presentation skills (process and model, purpose, gathering support materials, organizing and outlining, and developing visual aids).
3. Write various official communications, e.g., formal and informal letter, memos, and understand the difference between paraphrasing/precise/summary.
4. Identify the type of audience and the use of the required communication skills.
5. Familiarize with intercultural communication.
6. Use grammar and vocabulary skills.

#### **Content List**

1. **Introduction to Communication Skills**
  - a. Communication principles;
  - b. Process of communication;
  - c. Importance of good communication skills in business environments;
  - d. Communication in business organizations: Internal-operational; External-operational; Personal;
  - e. Challenge of communication in the global market.
2. **Study Skills**
  - a. Brainstorming;

- b. Time-management;
  - c. Effective reading strategies;
  - d. Notes-taking;
  - e. Organization;
  - f. Summarizing.
3. **Components of Communication**
- a. Sender – Encoder;
  - b. Message;
  - c. Medium;
  - d. Receiver – Decoder;
  - e. Feedback.
4. **Non-verbal Communication**
- a. Appearance and dress codes;
  - b. Body language;
  - c. Silence time and space;
  - d. Importance of listening in communication.
5. **Public Speaking**
- a. Difference between speech and writing;
  - b. Reading texts of good public speeches and analysis of their components;
  - c. Listening to famous public speeches;
  - d. Exercises in public speaking.
6. **Formal Presentations**
- a. Difference between informal and formal presentations;
  - b. Modes of formal presentation: Extemporaneous; Prepared; Reading out from a written text; combination of the above-mentioned methods.

### **Practicum**

Practice of different skills through presentations.

### **Bibliography/References**

1. Books:
  - a. Courtland Bovee, John V. Thill, "Business Communication Today", 11th Edition, Prentice Hall, 2011.
  - b. Mary Ellen Guffey and Dana Loewy, "Essential of Business communication" 2014.
  - c. Zane K. Quible, Margaret H. Johnson and Dennis L. Mott, "Introduction to Business Communication", ISBN: 0134790723
  - d. Herta A. Murphy, Herbert W. Hildebrandt and Jane P. Thomas, "Effective Business Communication" ISBN: 007044398X
2. Journals/Periodicals:
  - NIL

3. World Wide Web:  
NIL
- 

**Course code:** HU-106  
**Course title:** Pakistan Studies  
**Credit hours:** 2+0  
**Prerequisite:** Pre-Engineering or Equivalent

**Specific Objectives of Course:**

To teach the students history of Pakistan.

**Course Learning Outcomes (CLOs):**

1. Describe the history and ideology of creation of Pakistan.
2. Discuss the basic knowledge about Pakistan
3. Understand the present conditions of Pakistan, the problems, issues, needs and requirements in different fields such as a system of government, geography and natural resources, industry, economy, social structure etc.
4. Develop interest in Pakistan by highlighting common features in the fields of culture, language and literature.
5. Compare international affairs of Pakistan with Muslim state as well as Non-Muslim state.
6. Understand and evaluate the concepts of foreign policy.

**Content List**

1. **Ideology of Pakistan**
  - a. Definition and Explanation; Aims and objectives of formation of Pakistan;
  - b. Ideology of Pakistan in the light of the sayings and speeches of Allama Iqbal and Quaid-e-Azam.
2. **A Brief History of Muslim Society in Subcontinent**
  - a. The arrival of Muhammad Bin Qasim;
  - b. The Afghan invasions from north; The domination of Islam in the sub-continent;
  - c. The downfall of Muslim rulers and renaissance of Muslim rule in sub-continent.
3. **Historical Background of the Ideology of Pakistan: National and Reformative Movements**
  - a. Sh. Mujaddad Alf-e-Sani: Biography of Sheikh; Social and religious Services; Jihad against non- Islamic fundamentals; Difficulties of imprisonment; Effects of the movement;
  - b. Shah Wali Ullah: Biography of Jihad against non-Islamic fundamentals; Reforms, social and religious services; Jama'at-ul-Mujahiddeen;

- c. Sayyed Ahmad Shaheed: Biography; Jihad against Sikhs; Opposition from Afghan tribes; Martyrdom at Balakot; Mujahiddeen Movement.
4. **Educational Efforts**
    - a. Ali Garh;
    - b. Deoband;
    - c. Nadwah;
    - d. Anjuman Himayat-e-Islam;
    - e. Sindh Madrassat-ul-Islam;
    - f. Islamia College, Peshawar and other educational institutions.
  5. **Political Struggles**
    - a. Constitutional reforms and Muslims' separate electorate.
  6. **The Pakistan Movement**
    - a. Muslim Nationality: Evolution of two-nation theory;
    - b. Independence of India and Muslims: Presidential Address of Allama Iqbal at Allah Abad in 1930;
    - c. 1937 Elections: Congress's behavior;
    - d. The Pakistan Resolution;
    - e. 1946 Elections and transfer of power;
    - f. How to safeguard the ideological state in present era
  7. **Creation of Pakistan**
    - a. Role of scholars and Mashaikh, students and women, Journalists and Adeebis in the creation of Pakistan;
    - b. Initial difficulties after creation of Pakistan;
    - c. Anti-Muslim riots in India;
    - d. Massacre in East Punjab;
    - e. Canal water and distribution of assets;
    - f. Annexation of states: Hyderabad; Junna Garh;
    - g. Kashmir: Background and danger for the peace of South Asia.
  8. **The Land of Pakistan**
    - a. Geographical unity;
    - b. Location and importance;
    - c. Rural and urban areas;
    - d. Resources of agriculture, industry, workforce and education.
  9. **Efforts for Execution of Islamic System in Pakistan**
    - a. Objectives Resolution;
    - b. Islamic clauses of the constitutions of 1956, 1962 and 1973;
    - c. Implementation of Shariah: Practical steps;
    - d. Our Destination – Establishment of complete Islamic society.
  10. **Foreign Policy of Pakistan**
    - a. Principles of Pakistan's foreign policy;
    - b. Importance of Pakistan in Islamic world;
    - c. Formation of Islamic Summit;
    - d. Rabita-e-Alam-e-Islami;
    - e. Formation of Muslim Bank and Bloc;
    - f. Economic and defence planning;

- g. Pakistan in the changing world.

**Practicum**

NIL

**Bibliography/References**

1. Books:
  - a. Hamid Khan, "Constitutional and Political History of Pakistan", 2nd Edition, Oxford University Press, 2005.
  - b. S. Akbar Zaidi, "Issues in Pakistan's Economy", 2nd Edition, Oxford University Press, USA, 2006 ISBN: 9780195979145
  - c. Burki, Shahid Javed, "State and Society in Pakistan", The Macmillan Press Ltd.
  - d. S. M. Burke and Lawrence Ziring, "Pakistan's Foreign policy: A Historical analysis", Oxford University Press, Karachi. ISBN: 9780195774078
  - e. Mehmood, Safdar, 'Pakistan Political Roots and Development', Lahore. ISBN: 9788120711259
  - f. Wilcox, Wayne, "The emergence of Bangladesh: Problems and opportunities for a redefined American policy in South Asia (Foreign affairs study)", American Enterprise, Institute of Public Policy Research, Washington. ISBN: 9780844731124
  - g. Amin, Tahir, "Ethno – National Movement in Pakistan", Institute of Policy Studies, Islamabad.
  - h. Zahid Ansar, "History and Culture of Sindh", Karachi: Royal Book Company.
  - i. Afzal, M. Rafique, "Political Parties in Pakistan", Vol. I, II and III, National Institute of Historical and cultural Research, Islamabad.
  - j. Sayeed, Khalid Bin, "The Political System of Pakistan", Houghton Mifflin, Boston. ASIN: B0000D5J2X
2. Journals/Periodicals:

NIL
3. World Wide Web:

NIL

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<b>Course code:</b>	MA-109
<b>Course title:</b>	Differential Equations
<b>Credit hours:</b>	3+0
<b>Prerequisite:</b>	Calculus

**Specific Objectives of Course:**

To learn advance mathematical concepts.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Identify an ordinary differential equation and its order.
2. Develop fundamental skills of solving ordinary differential equations.
3. Classify ordinary differential equations into linear and nonlinear equations.
4. Develop differential equations to analyze and solve the engineering, social and other physical models.
5. Link practical application of petroleum engineering with differential equations.

### **Content List**

1. Laplace Transformation
  - a. Laplace transforms of elementary functions.
  - b. Unit step function,
  - c. Dirac's delta function,
  - d. Periodic functions,
  - e. Inverse Laplace transforms,
  - f. Convolution.
  - g. Applications.
2. Ordinary differential equations
  - a. System of differential equations,
  - b. Physical problems.
3. Fourier series
  - a. Periodic functions,
  - b. Fourier series for the function of period  $2\pi$ , even and odd functions.
  - c. Fourier series for functions having arbitrary period,
  - d. Half range expansions,
  - e. Complex form of Fourier series,
  - f. Application to physical problems.
4. Double Integrals and its Applications.
  - a. Double Integrals,
  - b. Geometrical interpretation.
  - c. Their applications in determining areas, volumes, centroids and moments of inertia,
  - d. Double integrals in polar coordinates.
5. Series solution of Differential Equations and Special Functions.
  - a. Beta and Gamma Functions,
  - b. Power series,
  - c. Method of Frobenius,
  - d. Legendre's differential equation,
  - e. Legendre polynomials,
  - f. Generating function,
  - g. Recurrence formulas,
  - h. Orthogonality,
  - i. Bessel's differential equation,
  - j. Bessel functions of first and second kind,



- k. Generating functions,
  - l. Recurrence formulas,
  - m. Orthogonality,
  - n. Modified Bessel functions.
6. Partial differential Equations (pdes)
- a. Basic concepts,
  - b. Derivation (modeling) of ID equations,
  - c. Solution using method of separation of variables,
  - d. D' Alembert solution of the wave equation,
  - e. Classification of linear second order P.D. equations,
  - f. Two dimensional partial differential equations (wave, heat and Laplace),
  - g. General solutions,
  - h. Laplace equation in Polar coordinates,
  - i. Laplace equation in cylindrical and spherical polar coordinates.

**Practicum**

NIL

**Bibliography/References**

1. Books:
  - a. Dennis G. Zill, Warren S Wright, "Differential equations with Boundary-Value Problems", 8th Edition, Cengage Learning, 2012.
  - b. John Warren Dettman," Introduction To Linear Algebra And Differential Equations", Mcgraw-Hill Kogakusha - Tokyo, 1974
  - c. Erwin Kreyszig, "Advanced Engineering Mathematics", ISBN: 9780470458365
  - d. Schaum's Outline Series, "Differential Equations" , ISBN: 0071611622
2. Journals/Periodicals:
 

NIL
3. World Wide Web:
 

NIL

**Course code:** CH-108  
**Course title:** Applied Chemistry  
**Credit hours:** 2+1  
**Prerequisite:** Pre-Engineering or Equivalent

**Specific Objectives of Course:**

A refresher course of chemistry to enhance quality and performance of graduates.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Define and discuss basic theories, terms and concepts applicable in the field of Petroleum Engineering.
2. Understand various types of material and phases and their chemical properties.
3. Understand various chemical processes and its quantitative analysis.
4. Develop skills for solving problems related to Petroleum Engineering.

**Content List**

1. Introduction to Chemistry
  - a. State of matter
  - b. Properties of solid, liquid, and gases
  - c. Periodic classification of elements.
  - d. Electronic Configuration and structure of atoms
2. Basic laws and principles
  - a. Physical principles involved in the study of properties of metals and nonmetals,
  - b. Solution, solubility,
  - c. Raoult's Law, Henry's law, Law of diffusivity. Theory of crystallization, chemical kinetics,
  - d. Viscosity, vapor pressure,
  - e. Chemistry of solutions, azeotropic solution, vapor pressure and distillation of partially-miscible and miscible liquids, diffusion, osmosis, theory of dilute solutions, relation with vapour pressure.
  - f. Chemical equilibrium
3. Organic Chemistry
  - a. Chemistry of hydrocarbon compound,
  - b. Cracking,
  - c. Polymerization,
  - d. Electrophilic and nucleophilic substitution in aromatic system.
4. Analytical Chemistry
  - a. Introduction to analytical instrumentation,
  - b. Concept of accuracy of analysis, separation techniques and gas chromatography, geochemistry,
  - c. Gas chromatography,
  - d. Basics of spectroscopy;
  - e. UV and visible spectroscopy.
  - f. Geo-chemical classification of elements,
  - g. Chemical weathering geo-chemical description,
  - h. Geo-chemical prospecting, significance and techniques

5. Electrochemistry
  - a. Electrolysis, electrolytic conductance, transport number and transport phenomena determination of transport number, ionic equilibria, activity coefficient electrolyte,
  - b. Debye-huckel theory, solubility products, galvanic cells, potentiometric titrations, pH, buffer solution, acid base indicators, molecular properties,
  - c. Surface tension, interfacial tensions, surface films surface-active agents, free energy and equilibrium, chemical equilibrium surface phenomena and catalysis,
  - d. Organic chemistry, electron displacement, resonance and its applications,
  - e. Mechanism and methods of determining, stereo chemistry, organic reaction, electrophilic substitution in aromatic system,
  - f. Addition to carbon-carbon and carbon-oxygen double bond, elimination reactions, inter-conversion of functional group, organic nitrogen compounds and heterocyclic system, aromatic series

#### **Practicum**

1. Determination of Heat of Solution of a given salt solution.
2. Determination of the Heat of Neutralization of given Acid-Base pair.
3. Determination of the Surface Tension of a given Liquid by using Stalagmometer.
4. Determination of Viscosity (absolute and relative) of a given liquid by using Ostwald's Viscometer.
5. Determination of the %age composition of colored ions by using Photoelectric Colorimeter.
6. Determination of the %age composition of two liquids by viscosity.
7. Determination of the %age composition of two liquids by Refractive Index.
8. Determination of the strength of Acid/base by pH-Metric Titration.
9. Determination of the Molecular weight of a given substance by Depression in Freezing Point (Cryoscopic) methods.
10. Determination of Transition Temperature of a substance by thermometric method.
11. Determination of the Molecular weight of a given substance by Elevation of Boiling Point (Ebullioscopic) methods.
12. Determination of adsorption of a solute by activated charcoal.
13. Determination of the strength of Acid/base by Conductometric Titration.
14. Preparation of Buffer solutions of various pH ranges (by pH-metric methods)

#### **Bibliography/References**

1. Books:

- a. Dennis G. Zill, Warren S Wright, "Differential equations with Boundary-Value Problems", 8th Edition, Cengage Learning, 2012.
  - b. John Warren Dettman," Introduction To Linear Algebra And Differential Equations", Mcgraw-Hill Kogakusha - Tokyo, 1974
  - c. Erwin Kreysizg, "Advanced Engineering Mathematics", ISBN: 9780470458365
  - d. Schaum's Outline Series, "Differential Equations" , ISBN: 0071611622
2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL
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**Course code:** ME-110  
**Course title:** Engineering Drawing  
**Credit hours:** 0+2  
**Prerequisite:** Pre-Engineering or Equivalent

**Specific Objectives of Course:**

To learn basic concepts of engineering drawing.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Elaborate the basic principles of developing, designing and drawing.
2. Perform basic sketching techniques, orthographic projections and sections, use of architectural and engineering scales, and to produce engineered drawings.
3. Possess knowledge of technical rules and regulations of Engineering Drawing and its evaluation.
4. Design Engineering Projects independently.

**Content List**

NIL

**Practicum**

1. Introduction to the subject use of instruments.
2. Introduction: Types of lines, lettering, dimensioning, and drawing instruments. Lettering and dimensioning the principal requirement of a working drawing.
3. Projection, Types of projection, orthographic projection. Plan of projection, four quadrants.
4. Planning of a drawing sheet, the projector of simple solids simple position, and the oblique and auxiliary planes.

5. Traces of a line, true length of line, inclination to both the planes, projection of planes.
6. Loci of Points. Loci of points and straight line, loci of crank mechanism.
7. Curves Used in Engineering Practice. Cycloid, Throchoid, epicyclide, Pitrochoid, hypotrochoid (superior and inferior).
8. Involute, evolute, archemedian, spiral.
9. Development of solids. Types of solids, polyhedra, solids of revolution, construction, of polygon, prism, pyramid, cylinder, cones sphere, (development of all solids with passing cutting plane).
10. Intersection of Surfaces. Intersection of cylinder and cylinder, cone and cylinder. Cone and prism.
11. Axonometric Projection. Types isometric projection of solids, planes and typical examples. Projection of Auxiliary Planes. Auxiliary planes and views, Projection of points, plane, true length of line. Projection of solids. True shape of section on auxiliary plane of various solids.
12. Isometric and pictorial projection of solid figures, making of freehand sketches from solid objects and from orthographic projection.
13. Section of solids, riveted joints.
14. Screw thread systems, nut and bolt, keys and cotter, coupling and simple bearings.
15. Pipe connections, engine detail.
16. Introduction of engineering drawing techniques in Auto CAD.

#### **Bibliography/References**

1. Books:
  - a. N. D. Bhatt, "Elementary Engineering Drawing Plane And Solid Geometry", 30th Edition, Charotar Publishing House, 1990
  - b. A. C. Parkinson," A First Year Engineering Drawing", Pitman - London, 1939
  - c. Warren J. Luzjader, 'Fundamentals of Engineering Drawing: With an Introduction to Interactive Computer Graphics for Design and Production", ISBN: 9788120308855
  - d. Baker, Arthur Latham, "The Elements of Solid Geometry", Boston, MA: Ginn and Co., 1893.
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

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**Course code:** CS-113  
**Course title:** Computer Programming and Software Applications

**Credit hours:** 2+1  
**Prerequisite:** Pre-Engineering or Equivalent

**Specific Objectives of Course:**

To teach students programming languages and software application.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand the local and global impact of computer programming on individuals, organizations and society.
2. Develop practical understanding of Programming language syntax, semantics and pragmatics.
3. Use computer programming to numerically solve engineering problems relating to interpolation, integration, differentiation, etc.
4. Solve common computation problems related to Petroleum Engineering Courses.

**Content List**

1. Introduction to Digital Computer Hardware.
2. Elements of Programming.
3. Programming Languages, Introduction to Operating systems and Compilers.
4. Problem analysis. Flow charts with algorithms.
5. Programming Examples and Exercises using C/C++ language (or any latest programming languages) with application to Engineering Problems.
6. Debugging Techniques.

**Practicum**

1. Programming exercises leading to developments of programs for engineering applications.

**Bibliography/References**

1. Books:
  - a. Robert Lafore, "Waite Group's Turbo C Programming for the PC", Rev Sub Edition, Financial Times Prentice Hall, 1988.
  - b. Peter H. Salus, "Programming Languages Handbooks Manuals, Object Oriented Programming Languages Handbooks Manuals, Techmedia - New Delhi, 1998.
  - c. Yashavant P. Kanetkar, "Let Us C", Infinity Science Press, 2008, 9781934015254
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

### SEMESTER-III

<b>Course code:</b>	HU-217
<b>Course title:</b>	Technical Writing and Presentation Skills
<b>Credit hours:</b>	2+0
<b>Prerequisite:</b>	Communication Skills

#### **Specific Objectives of Course:**

To teach presentations and report writing skills.

#### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand and communicate fluently in both oral and written English language.
2. Enhance current vocabulary to reflect a better usage of words in spoken and written language.
3. Develop employment communications, official correspondence, emails, proposals, interview and well-structured presentation skills, etc.
4. Analyze, comprehend, correct and re-produce technical and non-technical texts.
5. To communicate effectively in a team.

#### **Content List**

1. Written Communication
  - a. Organized writing of communicative paragraphs; Coherence and cohesive devices; Strength of unit in writing.
2. Correctness of Language
  - a. Importance of clarity in writing; Elements of clear writing: Directness; Brevity; Pitfalls to avoid; Hackneyed phrases; Redundancies; Slang; Passive voice; E-language; Sentence length; Specific Words and concrete words.
3. Business Correspondence
  - a. Memorandums: Types of memos: Status negative; Personal; Analysis of samples;
  - b. Minutes of a meeting;
  - c. E-mails: When and how to write an e-mail? Etiquettes of e-mailing;
  - d. Resume and cover letter writing;
  - e. Applications and follow-up letters;
  - f. Business Letters: Format; Elements;
  - g. Language: How to write?
  - h. Language to avoid;
  - i. Analysis of sample letters;
  - j. Practice exercises on different types of official correspondence.

4. Interview Skills
  - a. Handling the interview;
  - b. Investigating about the company;
  - c. Making good appearance;
  - d. Anticipating questions and preparing answers;
  - e. Making oneself at ease – increasing confidence level ;
  - f. Successful preparation of an interview: Knowing one's submitted resume well; Knowing the company applied to; Knowing the requirements of the available positions; Knowing the importance of non-verbal appearance; Knowing the importance of rehearsals.
5. Phonetics and Phonology
  - a. Phonetic symbols;
  - b. Transcribing;
  - c. Assimilation and elision;
  - d. Use of dictionary;
  - e. Stress patterns Intonation (practice in reading skills);
  - f. First language interference in individual pronunciation.
6. Vocabulary Building
  - a. Techniques of building word power;
  - b. Importance of reading as a voluntary habit and a vocabulary builder;
  - c. Correct word usage;
  - d. Synonyms;
  - e. Ladder of accuracy;
  - f. Words easily confused;
  - g. Words with dual function.
7. Written Reports
  - a. Daily reports;
  - b. Research methodology;
  - c. Types of reports;
  - d. Formal and informal reports;
  - e. Executive summary; Scope; Purpose; Introduction; Writing the main report; Conclusion; Bibliography;
  - f. APA and MLA styles;
  - g. Plagiarism: What is plagiarism? How it can be avoided?
8. Presentations and Seminars

#### **Practicum**

NIL

#### **Bibliography/References**

1. Books:
  - a. Introduction to Business Communication by Zane K. Quible, Margaret H. Johnson and Dennis L. Mott, ISBN: 0134790723



- b. Business Communication Today by Courtland L. Bovée, John V. Thill and Barbara E. Schatzman ISBN: 0130928585
  - c. Effective Business Communication by Herta A. Murphy, Herbert W. Hildebrandt and Jane P. Thomas, ISBN: 007044398X
  - d. Business Presentation by Lani Arredondo, ISBN: 0070028400
- 2. Journals/Periodicals:  
NIL
  - 3. World Wide Web:  
NIL

**Course code:** MA-215  
**Course title:** Complex Variables and Linear Transform  
**Credit hours:** 3+0  
**Prerequisite:** Differential Equations

**Specific Objectives of Course:**

To learn advance mathematical concepts (Vector and tensor analysis).

**Course Learning Outcomes (CLOs):**

- 1. Develop understanding of function of complex variable and carry out basic mathematical operations with complex numbers.
- 2. Understand and describe Cauchy Riemann Equation and Taylor's and Laurent's series.
- 3. Apply the concepts, theories, and operational implementation of vectors, and more generally tensors, in advanced engineering analysis.

**Content List**

- 1. Complex Variables
  - a. Functions,
  - b. Limits and Continuity,
  - c. Derivatives,
  - d. Analytic functions,
  - e. Cauchy-Reimann equations,
  - f. Elementary complex functions (Exponential, Trigonometric, Hyperbolic, Logarithmic etc.), simply multiply connected regions,
  - g. Complex integration,
  - h. Cauchy's theorem,
  - i. Cauchy's integral formula,
  - j. Convergence and Radius of Convergence of Power Series,
  - k. Taylor's and Laurent's series,
  - l. Zeros and singularities,
  - m. Poles, Residues,

- n. The residue theorem,
  - o. Contour integration,
  - p. Conformal mapping.
2. Advanced Vector Analysis
    - a. Scalar and vector point functions,
    - b. Gradient and its geometrical interpretation,
    - c. Directional derivative,
    - d. Divergence and Curl and their physical interpretations,
    - e. Vector identities,
    - f. Line integrals,
    - g. Conditions for a line integral to be independent of path, surface and volume integrals,
    - h. Green's theorem in the plane,
    - i. Gauss' divergence theorem and Stocks theorem.
  3. Cartesian Tensors
    - a. Summation convention,
    - b. Kronecker delta,
    - c. Alternating symbol,
    - d. Relation between alternating symbol and Kronecker delta,
    - e. Tensor of first, second and tensors,
    - f. Differentiation of tensors,
    - g. Application to vector analysis,
    - h. Eigen values and Eigen vectors of a tensor.

**Practicum**

NIL

**Bibliography/References**

1. Books:
  - a. Advanced Engineering Mathematics, H. K. Dass, ISBN: 8121903459.
  - b. Advanced Engineering Mathematics, Dr. B. S. Grewal. ISBN: 8174091955
  - c. Advanced Engineering Mathematics, Erwin Kreysizg, ISBN: 9780470458365
  - d. Complex Analysis by Schaum's Outline Series, ISBN: 0071615695.
  - e. Vector Analysis by Schaum's Outline Series ISBN 0071615458
  - f. Tensor Calculus by Schaum's Outline Series ISBN 0071756035
2. Journals/Periodicals:
 

NIL
3. World Wide Web:
 

NIL

**Course code:** CE-216  
**Course title:** Fluid Mechanics  
**Credit hours:** 2+1  
**Prerequisite:** Pre-Engineering or equivalent

**Specific Objectives of Course:**

To develop the concepts of fluid mechanics, and their applications.

**Course Learning Outcomes (CLOs):**

1. Understand the basic principles of fluid mechanics and its application on types of flow.
2. Perform a basic analysis of static and dynamic fluid systems.
3. Carry out basic design calculations of fluid engineering systems (pumps, compressors etc.)
4. Apply their understanding and analysis on real-life problems related to equipment.

**Content List**

1. Fluid Statics
  - a. Stress and pressure,
  - b. The basic equations of fluid statics,
  - c. Pressure distribution,
  - d. Head calculations,
  - e. Buoyancy,
  - f. Static forces on solid boundaries
2. Nature of Flow
  - a. Laminar and turbulent flow for Newtonian fluids, laminar and turbulent flow for Non-Newtonian fluids,
  - b. Bernoulli's equation and its applications, continuity equation, energy relationships and the Bernoulli equation, pressure terminology.
3. Stress in Fluids
  - a. Viscosity,
  - b. Newton's Law of Viscosity,
  - c. Shear Stress Components in Newtonian and non-Newtonian flow.
4. Momentum of a Flowing Fluid
  - a. Newton's 2<sup>nd</sup> law of motion and momentum balance,
  - b. Calculations for laminar and turbulent pipe flow, nozzle flow and other example, flow of incompressible Newtonian fluids in pipes and channels,
  - c. Friction factor and pressure drop, losses in fittings and bend pipes, enlargements and contractions.
5. Flow Measurement Devices
  - a. Orifice meter, Venturi meter, Rota meter, Nozzle.
  - b. Notch and Wier, Electromagnetic flow meter and others

6. Pumps and Compressors
  - a. Pumps and its classification, pump characteristics, pumping requirement and pump selection, required head and composite curves,
  - b. Cavitation and net positive suction head (NPSH), vapor lock and cavitation, NPSH, specific speed and suction specific speed, pumps in series and parallel,
  - c. Compressors and its classification, isothermal compression, isentropic compression, staged operation, efficiency.

### **Practicum**

1. Measurement of following liquid properties
  - a. Density
  - b. Specific Weight
  - c. Specific Volume
  - d. Surface Tension
  - e. Viscosity
2. To determine the stability of floating bodies and measure the meta-centric height
3. To determine the magnitude of hydrostatic force and center of pressure
4. To validate the Bernoulli's theorem
5. To measure flow rate through pipe using venture meter and to calibrate it
6. To measure flow rate through an orifice and to calibrate it
7. To measure flow rate in an open channel by Notch and to calibrate it
8. To determine the coefficient of discharge of an Orifice Meter.
9. To determine the coefficient of discharge of Notch (V, Rectangular and Trapezoidal types).
10. To determine the friction factor for the pipes.
11. To determine the coefficient of discharge of Venturi meter.
12. To determine the coefficient of discharge, contraction and velocity of an orifice.
13. To verify the Bernoulli's Theorem.
14. To find critical Reynolds number for a pipe flow.
15. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
16. To study Velocity, Viscosity and Pressure measuring device.

### **Bibliography/References**

1. Books:
  - a. Bruce R. Munson , Donald F. Young , Theodore H. Okiishi, Wade W. Huebsch "Fundamentals of Fluid Mechanics", 6th Edition, Wiley, 2010
  - b. Robert Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, "Transport Phenomena", 2nd Edition, John Wiley & Sons,

- 2007
- c. Fanzini, J Band E J Finnemore, "Fluid Mechanics with Engineering Applications, 9th Edition or latest, WCB/McGraw Hill, 1997
  - d. White, F M, "Fluid Mechanics" 4th Edition, McGraw Hill, 1999
  - e. Douglas J F, J M Gasiorek and J A Swaffield, "Fluid Mechanics" 2nd Edition, Longman Publishing Group.
2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL

**Course code:** EE-214  
**Course title:** Principles of Electrical Engineering  
**Credit hours:** 2+1  
**Prerequisite:** Pre-Engineering or equivalent

**Specific Objectives of Course:**

To learn basic concepts of Electrical Engineering.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Get familiar with fundamental concepts in Electrical Engineering.
2. Understand the interaction of electrical and magnetic circuits and their role in operating principle of electrical machines.
3. Explain construction and operation principle of transformers and Induction Motors.
4. Analyze, design and test electrical circuits.

**Content List**

1. Electric and Magnetic Circuits
  - a. AC Poly Phase systems,
  - b. DC Machines,
  - c. AC Synchronous Machines,
  - d. AC Induction Machines.
2. Induction Motors
  - a. Construction,
  - b. Types,
  - c. Rotating field theory principle of working,
  - d. Slip and its effect on motor current quantities.
  - e. Losses Efficiency and performance curves Starting,
  - f. Full load maximum torque relations, and
  - g. Torque slip characteristics.
3. Transformers;
  - a. Converting Machines;

- b. Rotary Converters; Construction; Principle of working; Transformer connections, Voltage and current ratings of single and three phase converters;
- c. Mercury arc rectifiers, Construction, Operation; Transformer connections, Voltage and current ratios of single phase and three phase rectifiers.

### **Practicum**

1. Study and Use of Oscilloscope.
2. Resistance Measurement by Color Code and its Comparison with the Ohm-Meter Reading.
3. Study of Ohm's Law.
4. Study and Proof of Kirchhoff's Current Law (Nodal Analysis)
5. Study and Proof of Kirchhoff's Voltage Law (Loop Analysis). RC Time Constants.
6. To Plot the Capacitor charging and Discharging Curves using Oscilloscope.
7. To Draw Vector Diagram of an A.C circuit containing,
  - a. Resistance and Inductance in Series,
  - b. Resistance and Capacitance in Series,
  - c. Resistance, Inductance and Capacitance in Series.
8. To study the Effect of Frequency Variation on an R-L-C Series Resonant Circuit.
9. Power Measurement in a 3-Phase
10. Star Connected Balanced Resistive Load by Two Wattmeter Method and Verification of Relations:
  - a. Line Voltage = 3 Phase Voltage,
  - b. The current in the neutral conductor is zero
  - c. Sum of Two Wattmeter Readings Total power in the Circuit

### **Bibliography/References**

1. Books:
  - a. B. L. Theraja, A. K Theraja, "Textbook of Electrical Technology", 25 Edition, Chand (S.) & Co Ltd ,India, 2012.
  - b. Robert L. Boylestad, "Introductory Circuit Analysis", 12th Edition. Prentice Hall, 2010.
  - c. Stephen J. Chapman, "Electric Machinery Fundamentals", 4th Edition McGraw-Hill Science/Engineering/Math, 2003
  - d. Admiralty," Examples in Electrical Calculations" ASIN: B003MR22VS
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

<b>Course code:</b>	PG-203
<b>Course title:</b>	Petroleum Geology and Geophysical Exploration
<b>Credit hours:</b>	3+0
<b>Prerequisite:</b>	Applied Geology

**Specific Objectives of Course:**

To learn dynamics of earth's structural formations and develop an understanding of hydrocarbon reservoir formations and methods of exploration.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand basic principles of petroleum exploration and field development.
2. Describe theories, methods and applications of petroleum geology
3. Understand the principles of sedimentation and stratigraphy.
4. Solve geological problems by integrating different types of data used in the oil industry.
5. Draw geological maps and interpret seismic sections
6. Understand the sedimentary Basins and tectonic history of Pakistan.

**Content List**

1. Geological history of petroleum.
2. The origin, migration and accumulation of petroleum.
3. Reservoirs with abnormal pressure and temperature.
4. Geological distribution of petroleum in the world.
5. Geological basins of Pakistan.
6. Geology of existing oil and gas fields in Pakistan.
7. Surface geological methods for petroleum exploration.
8. Use of topography and surface features for oil prospecting.
9. Modes of deformation of rocks, parts.
10. Classification of Folds, faults, joints and unconformities.
11. Expression of the above features on geological field maps and construction of cross sections.
12. Geological mapping and the application of photogrammetry.
13. Geophysical exploration methods with emphasis on seismic survey.
14. History of exploration in Pakistan.
15. Principles of Stratigraphy:
16. Stratigraphy of Pakistan with special emphasis on salt range.
17. Introduction to structural geology and its objectives.
18. Interpretation of pore pressure and fracture gradient profiles from seismic data.

**Practicum**

NIL

### **Bibliography/References**

1. Books:
    - a. Robert J. Twiss, Eldridge M. Moores, "Structural Geology", 2nd Edition, W. H. Freeman and Company, New York, 2007.
    - b. Peter K. Link, "Basic Petroleum Geology", Oil and Gas Consultants International - Tulsa, Oklahoma, 2001.
    - c. Richard C. selley, " Elements of petroleum geology", 2nd Edition, 1997
    - d. Richard H. Groshong, "3-D Structural Geology", 2nd Edition, Springer, 2008.
    - e. William Lowrie, "Fundamentals of Geophysics", 2nd Edition, 2007
  2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL
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**Course code:** CH-218  
**Course title:** Applied Thermodynamics  
**Credit hours:** 2+1  
**Prerequisite:** Applied Chemistry and Applied Physics

### **Specific Objectives of Course:**

To learn principles of mechanical and chemical thermodynamics.

### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand the fundamentals of applied thermodynamics
2. Identify and describe energy exchange processes.
3. Apply the Laws of thermodynamics on different systems. (Heaters, coolers, pumps, turbines, pistons, etc.)
4. Understand the calculation of heat and work quantities for physical processes.
5. Explain the underlying principles of phase equilibrium (PVT) in two-component and multi-component systems.

### **Content List**

1. Introduction to thermodynamic systems and processes, equilibrium, thermodynamic variables, intensive and extensive variables, thermodynamic properties, state functions, derived intensive variables.
2. Types of work, kinetic and potential energy, the first law of thermodynamics, internal energy, energy transfer by heat, energy balance, energy analysis of cycles.
3. Quasi-static processes, reversibility, heat capacities.



4. Property relations relevant to engineering thermodynamics, P-V-T relation, evaluating thermodynamic properties, generalized compressibility chart Ideal gas model, internal energy, enthalpy and specific heat of ideal gases, evaluating changes in specific enthalpy and internal energy for ideal gases, polytrophic process of an ideal gas.
5. Introducing the control volume, conservation of mass and energy in a control volume, Steady-state and transient forms of mass and energy rate balances.
6. Second law of thermodynamics, irreversible processes, entropy.
7. Applying the second law to thermodynamic cycles, the Carnot cycle.
8. The Clausius inequality, entropy changes, evaluating entropy data.
9. Entropy balance for closed systems, entropy rate balance for control volumes, isentropic processes, isentropic efficiencies of turbines, nozzles, etc.
10. Equations of state, property relations from exact differentials, fundamental thermodynamic functions, relations for gas mixtures and multi-component systems, the Gibbs-Duhem relation.
11. Applications to flow processes, nozzles, turbines, compressors, Heat Engines, Refrigeration and Air Conditioning, and Liquefaction of gases.
12. Thermal expansion coefficients of metals, thermal conductivity of liquids, thermal radiation and Stefan Boltzmann law, steam power plant, refrigeration unit, freezing point depression, PVT cell.

### **Practicum**

1. Measurement of following liquid properties
  - a. Density
  - b. Specific Weight
  - c. Specific Volume
  - d. Surface Tension
  - e. Viscosity
2. To examine the relation between temperature and pressure for saturated steam.
3. To produce energy balance for small steam plant.
4. To study the performance of small high-speed steam motor.
5. Calculation of coefficient of performance for the refrigeration machine
6. Study and operation of a vapor compression refrigeration unit.
7. Study and operation of Heating ventilation and air conditioning Unit (HVAC)
8. Study and operation of air flow rig
9. Determination of thermal conductivity of different metal specimens using Fourier's law apparatus
10. Study of performance of parallel and counter flow heat exchanger

11. Determination of heat transfer coefficient for natural and forced convection from pinfin.

### **Bibliography/References**

1. Books:
  - a. Smith J.M., Van Ness H.C., Abbott M.M. "Chemical Engineering Thermodynamics" 8thEd. McGraw-Hill International Edition, 2005.
  - b. Daubert Thomas E. "Chemical Engineering Thermodynamics", 1stEd., McGraw-Hill Book Company, 1985.
  - c. Sandler Stanley I. "Chemical and Engineering Thermodynamics" 3rdEd. John Wiley and Sons, Inc.
  - d. Moran M. J., Shapiro H. N., "Fundamentals of Engineering Thermodynamics" 6th Ed. John Wiley and Sons, Inc.
  - e. Cengel, Y. A., Boles, M. A., "Thermodynamics: An Engineering Approach", , McGraw-Hill, 2008
  - f. Thomas D. Eastop, A. McConkey, "Applied Thermodynamics for Engineering Technologists", 5th Edition, Prentice Hall, 1996.
  - g. S. S. Thipse," Advanced Thermodynamics", Narosa Publishing House - New Delhi, 2013.
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

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### **SEMESTER-IV**

<b>Course code:</b>	PET-211
<b>Course title:</b>	Principles of Corrosion Control
<b>Credit hours:</b>	3+0
<b>Prerequisite:</b>	Applied Chemistry

#### **Specific Objectives of Course:**

To enable the students to understand corrosion principles and control.

#### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Define fundamentals of corrosion and its types.
2. Understand corrosion causes, measurements, monitoring and prevention strategies.
3. Acquire and interpret relevant corrosion-related data from the literature and analyse a range of practical corrosion-related problems.

4. Use standard corrosion testing methods and prevention technologies.

### **Content List**

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

### **Practicum**

NIL

### **Bibliography/References**

1. Books:
  - a. A.W. Peabody, "Control of Pipeline Corrosion", National Association of Corrosion Engineers, 1967
  - b. Pierre R. Roberge, "Handbook of Corrosion Engineering", McGraw-Hill
  - c. Mars Fontana, "Corrosion Engineering (Materials Science & Engineering)", 3rd Edition, McGraw-Hill Companies, 1986.
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

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<b>Course code:</b>	PET-212
<b>Course title:</b>	Unconventional Reservoirs
<b>Credit hours:</b>	3+0
<b>Prerequisite:</b>	Pre-Engineering or Equivalent

**Specific Objectives of Course:**

To enable the students to understand unconventional reservoirs.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Discuss the fundamentals of different types of unconventional hydrocarbon resources.
2. Understand the economics, social, political and environmental issues related to the development of unconventional reservoirs.
3. Calculate the reserves of unconventional reservoirs.
4. Understand basic measurement techniques for characterization of unconventional resources.

**Content List**

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

**Practicum**

NIL

**Bibliography/References**

1. Books:
  - a. Reza Rezaee, "Fundamentals of Gas Shale Reservoirs" 2015.
  - b. Usman Ahmed and Nathan Meehan; Unconventional Oil and Gas Resources-Exploitation and Development, CRC Press, 2016, pp 860

- c. Ma and Holditch, "Unconventional Oil and Gas Resources Handbook: Evaluation and Development", 1st Edition, Elsevier, 2015
  - d. A Guide to Coal-bed Methane Operations, Gas Research Institute, GRI, Chicago, 1992.
2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL

**Course code:** MA-218  
**Course title:** Probability and Statistics  
**Credit hours:** 3+0  
**Prerequisite:** Differential Equation, Calculus

**Specific Objectives of Course:**

To learn different statistical methods to obtain the measure of central values of data and their interpretation.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand the fundamental concepts in Probability and Statistics.
2. Apply the rules and algorithms of Probability and Statistics; to generate probabilistic models.
3. Interpret probabilistic models for application to engineering problems.

**Content List**

1. Basic probability,
2. Random variables and probability distributions,
3. Measures of central tendency.
4. Measures of dispersion.
5. Frequency distributions Binomial Normal,
6. Poisson, Cauchy, Gamma, Beta, Chi-square, student's-t, and F-distributions,
7. Bivariate Normal Distribution,
8. Estimations and hypothesis testing,
9. Confidence intervals Analysis of variance.
10. Curve fitting, Regression analysis, and correlation, Auto and Cross correlation.
11. Analysis of Time series.
12. Linear – simple and multiple Polynomial – power, orthogonal, nonlinear, step – wise.
13. Correlation.
  - a. Auto and Cross correlation.

- b. Time trend analysis, filtering, moving averages data smoothing.

**Practicum**

NIL

**Bibliography/References**

1. Books:
    - a. Walpole, Myers, Myers &Ye, Probability and Statistics for Engineers and Scientist, Latest edition.
    - b. Allan G. Bluman, Elementary Statistics A step by step approach, Latest edition.
    - c. Douglas C. Montgomery, Applied Statistics and Probability for Engineers, Latest edition
    - d. Prof Sher Muhammad Ch. and Dr. Shahid Kamal, "Introduction to Statistical Theory Part – I", Illmi Kitab Khana, Urdu Bazar, Lahore
  2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL
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**Course code:** CE-205  
**Course title:** Surveying and Levelling  
**Credit hours:** 2+1  
**Prerequisite:** NA

**Specific Objectives of Course:**

To teach the students basic theoretical concepts of Surveying and levelling.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand basic concepts of engineering surveying as applied in Petroleum Engineering.
2. Identify and evaluate environmental and sustainable land planning concepts.
3. Use modern survey equipment for measurement purpose.

**Content List**

**1. 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.

**2. Measurement of Horizontal Distances:** Methods of Linear measurement, Types of Measurement, Chains, Tapes, Standard conditions for use of Steel tapes, Taping Accessories and their use, Systematic Taping Errors and Corrections, Random Taping Errors and Mistakes in Taping, Field notes for Taping, Conventional and Electronic Field books.

**3. Levelling:** Definitions, Theory of Differential Levelling, Effects of Curvature and Refraction, Types of Levels, Automatic Level, Digital Level, Adjustment of Levels, Types of Levelling Staff, Levelling Operations, Techniques of Levelling, Benchmark Levelling (Vertical Control Survey), Profile and Cross-section Levelling, Reciprocal Levelling, Peg test, Errors in Levelling, Contours and their characteristics, Various methods of Contouring.

**4. Angles and Directions:** Horizontal and Vertical Angles, Meridians, Types of Horizontal angles, Azimuths, Bearing, Relationship between Bearings and Azimuths, Reverse Directions, Azimuth and Bearings computations, Magnetic Declination, Types of Compasses.

**5. Theodolites / Tacheometers:** Introduction, Types of Theodolites, Repeating, Directional and Electronic Theodolites, Temporary adjustments, Measurement of Horizontal and Vertical Angles, Prolonging a Straight Line, Permanent Adjustments, Use of Tachometers in computation of Horizontal and Vertical Distances.

**6. Traverse Surveys:** Open and Closed Traverses, Latitude and Departures, Computation of Error of Closure, and the accuracy of a Traverse, Traversing with Total Station Instruments, Rules of Adjustment, Effects of Traverse Adjustments on the original data, Computation of Omitted Measurements, Area of Closed Traverse Methods, Use of computer programs.

**7. An Introduction to Geomatics and Global Positioning System:** Geomatics defined, Branches of Geomatics, Remote Sensing, Techniques of remote sensing, Background information on global positioning, receivers, Satellites, Errors, GPS Surveying techniques and applications.

#### **Practicum**

1. To determine the difference in elevation of two given points
2. Profile levelling of a path
3. To measure horizontal angle at a points by the method of Reiteration and Repetition.
4. To plot a Traverse using deflection angle method.

5. To measure interior angles at each station of closed traverse having “n” sides using the method for measuring angle by repetition method.
6. To observe the distance using the EDM equipment of a base line previously measured over level terrain by an invar or steel tape in order to determine the systematic errors in the EDM system.
7. Basic operations of Hand Held GPS receiver
8. Initialization of Hand held GPS
9. To locate the coordinates of different building around Campus using Hand Held GPS.
10. Introduction to Total Station and to determine the elevation, Horizontal / Vertical angle and the distance between two Inaccessible points
11. To understand the basics of DGPS and to acquaint with DGPS equipment

#### **Bibliography/References**

1. Books:
  - a. Barry F. Kavanagh, “Surveying: Principles and Applications “, Fifth Edition, Prentice Hall, 2000
  - b. A. Ashworth, B. C. Heath,” Advanced Quantity Surveying”, Butterworth- Heinemann - London, 1983.
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

**Course code:** CE-220  
**Course title:** Mechanics of Materials  
**Credit hours:** 2+1  
**Prerequisite:** Engineering Mechanics

#### **Specific Objectives of Course:**

To teach the students effect of forces on the dynamics of materials.

#### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand the fundamental concepts of stress, strain, buckling, geometrical properties and materials properties in tension and compression.
2. Learn the beams and short columns design concepts.
3. Develop and solve problems of the stress on a beam section, circular shafts and short columns due to tension, compression, torsion, bending, shear, combined loading etc.

#### **Content List**

1. Types of stresses and strains.



2. Load extension diagrams.
3. Hooke's Law.
4. Temperature stresses.
5. Geometrical properties of plane areas. (Centroid, Moment of Inertia and Product of Inertia) Shearing Force and Bending Moments for simply supported beams, Cantilever and overhanging beams.
6. Theory of simple Bending and Shearing Stresses in beams.
7. Theory of Torsion in circular shafts (solid and hollow).
8. Short Columns.
9. Combined bending and direct stresses.
10. Euler's Theory of buckling for long column-Empirical formula.
11. Mechanical properties of metals and timber in tension and compression.
12. Principles of testing machine.
13. Impact Loads.
14. Hardness.
15. Failure criteria.

#### **Practicum**

1. Layout Plan of Strength of Materials Laboratory.
2. Study of small instruments.
3. To perform direct shear test on plain mild steel bar.
4. To perform punching shear test on plain mild steel bar.
5. To perform tension test on plain mild steel bar.
6. To perform compression test on wooden cubes, when load is applied: -
  - a. Perpendicular to grain.
  - b. Parallel to the grains.
7. To perform hardness test on mild steel and High Carbon steel specimen.
8. To perform bending test on wooden beam.
9. To verify the principle of superposition by beam deflection.
10. To perform impact test on steel specimen: -
  - a. In tension.
  - b. In bending.

#### **Bibliography/References**

1. Books:
  - a. Andrew Pytel, Ferdinand L. Singer, "Strength of Materials", 3rd Edition, Harper and Row, 1998.
  - b. Robert R. Archer, Stephen H. Crandall, Norman C. Dahl, "An Introduction To The Mechanics Of Solids", Mcgraw-Hill - New York, 1959.
  - c. R.C.Hibbeler, "Mechanics of Materials", 8th Edition, Prentice Hall, 2011

2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL
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**Course code:** PG-202  
**Course title:** Drilling Engineering - I  
**Credit hours:** 3+1  
**Prerequisite:** Fundamentals of Petroleum Engineering

**Specific Objectives of Course:**

To learn the basics of drilling operations.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Describe the fundamental concepts of drilling engineering.
2. Explain the functions of various components of drilling system.
3. Identify, compute, analyze and solve drilling problems.
4. Formulate the pressure requirement at every stage of the drilling operation from the pump to the bit and back to the surface based on rheological models and drilling hydraulics procedures and the API recommended practices.

**Content List**

1. Rotary drilling operations.
2. Working principles of various components of Rig systems.
3. Mud Pumps, types and horsepower requirement.
4. Drill Lines and Ton Miles calculations.
5. Drill Bit types and selection.
6. Drilling fluids: functions, types, and compositions.
7. Mud properties and calculations.
8. Pressure relationship in the formation and bore hole, ECD concept, Total system pressure drop calculations.
9. Bottom Hole assembly concept for vertical wells.
10. Concept of Long Lead Items and AFE.

**Practicum**

1. Introduction of different models of rig components.
2. Determination of mud density using Mud Balance
3. To determine the properties of different clays.
4. Prepare a mud of known density.
5. To determine the gel strength of a drilling mud using viscometer.
6. To determine the plastic viscosity, apparent viscosity and Bingham yield point and true yield point using viscometer.
7. To determine the oil, water, solids and clay content of the drilling mud.

8. To determine API gravity and specific gravity of drilling mud.
9. To determine the gel strength of a drilling mud using Rheometer.
10. To determine the viscosity using Rotational Viscometer.
11. To prepare mud cake by Standard Filter Press and Mud Cell Assembly.
12. To study the filtration loss quality of a drilling mud by Miniature Filter Press.
13. To determine the clay/sand contents of the drilling mud using Sieve Analysis.

### **Bibliography/References**

1. Books:
  - a. A. T Bourgoyne jr., K. K. Millehim, "Applied Drilling Engineering", ISBN: 1555630014.
  - b. J. L. Lummus, "Drilling Fluids Optimization: A Practical Field Approach", ISBN: 0878143068.
  - c. Hussain Rabia, "Oil Well Drilling Engineering, Principles and Practice", ISBN: 0860107140.
  - d. Hussain Rabia "Fundamentals of Casing Design", ISBN: 0860108635
  - e. Steve Devereux, "Drilling Technology in Nontechnical Language", Pennwell Publishing; 1999.
  - f. Halliburton cementing, casing and cement data tables prepared by Halliburton Company.
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

**Course code:** PG-304  
**Course title:** Petrophysics  
**Credit hours:** 3+1  
**Prerequisite:** Fundamentals of Petroleum Engineering, Petroleum Geology and Geophysical Exploration

### **Specific Objectives of Course:**

To study the physical properties of rocks.

### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Define the fundamental petrophysical properties and the factors affecting them.
2. Design and conduct experiments to measure properties of rocks.
3. Compute the rock properties from different methods (correlations, lab measurements etc.).

4. Prepare and examine the collected data for petroleum field development.

#### **Content List**

1. Introduction to porous media.
2. Fundamental properties of fluid permeated rocks; porosity, permeability, fluid saturations, wettability, capillary pressure, compressibility and surface kinetics.
3. Core-sampling and preservation.
4. Introduction to RCA and SCAL.
5. Measurement of basic rock properties.
6. Interpretation and application of basic core analysis data.
7. Special rock properties including electrical, mechanical, acoustic and thermal.
8. Use of correlations for the calculation of petrophysical properties with the help of computer.

#### **Practicum**

1. To determine the grain density of given core sample.
2. To find the fluid saturation in the given core sample using modified ASTM Saturation Method.
3. To clean the given core sample using ASTM Extraction Methods.
4. To clean the given core sample using Soxhlet Extraction Methods.
5. To find the fluid saturation in the given core sample using Retort Oven.
6. To find the porosity of the given sample using Gravimetric Method.
7. To find the porosity of the given sample using Volumetric Method.
8. To calibrate Helium Porosimeter.
9. To measure the porosity of the given sample using Helium Porosimeter.
10. To measure the permeability of given core sample using Gas Permeameter.
11. To measure the permeability of given core sample using Liquid Permeameter.

#### **Bibliography/References**

1. Books:
  - a. Djebbar Tiab, Erle C. Donaldson, "Petrophysics: Theory and Practice of Measuring Reservoir Rock and Fluid Transport Properties", 3rd Edition, Elsevier, 2012.
  - b. Richard L.Christiansen," Multiphase flow through porous media",KQN Engineering 2008.
  - c. James W. Amyx," d.Petroleum Reservoir Engineering: Physical Properties", ISBN: 0070016003.
2. Journals/Periodicals:  
NIL

3. World Wide Web:  
NIL

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**Course code:** HU-222  
**Course title:** Social Sciences  
**Credit hours:** 3+0  
**Prerequisite:** Pre-Engineering or equivalent

**Specific Objectives of Course:**

To teach the students about social needs.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Examine, understand, and evaluate conflicting viewpoints to foster respect for human diversity, particularly with regard to matters of gender, race and ethnicity.
2. Deal and work effectively with a range of public within and/or outside the organization.
3. Demonstrate ethical and professional attitude in corporate environment.
4. Formulate entrepreneurship plans.
5. Develop skills in oral and written communication.

**Content List**

Contents are at Annex A.

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**SEMESTER-V**

**Course code:** CS-321  
**Course title:** Applied Numerical Methods  
**Credit hours:** 2+1  
**Prerequisite:** Complex Variables and Linear Transform

**Specific Objectives of Course:**

To teach numerical techniques for solving non-linear equations.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand the basics of elementary function and their applications.
2. Describe the difference between numerical and analytical methods and solutions.
3. Identify main sources of errors and take steps to eliminate or reduce the impact of errors
4. Apply numerical methods to solve petroleum engineering problems.

## **Content List**

1. **Approximation and Errors**
  - a. Accuracy,
  - b. Truncation,
  - c. Taylor series and bracketing methods
2. **Linear Equations**
  - a. Gauss elimination,
  - b. Eigen Values.
3. **Non-Linear Equations**
  - a. Bisection method,
  - b. iteration,
  - c. secant method,
  - d. Newton-Raphson method,
  - e. System of Nonlinear Equations and,
  - f. Convergence etc
4. **Numerical Differentiation and Integration**
  - a. Accuracy of derivatives,
  - b. Newton-Cotes Integration Formulae,
  - c. Integration for multiple and improper integrals.
5. **Interpolation and Curve Fitting Methods**
  - a. Binary Search,
  - b. approximation,
  - c. Lagrange polynomials,
  - d. Inverse type,
  - e. Least Squares and,
  - f. Orthogonal Polynomials including rational and spline function.

## **Practicum**

Lab part of the course will include Mathematica 11, or Matlab 2016. The introductory programming with course work related to the course outline shall be carried out.

## **Bibliography/References**

1. Books:
  - a. C. Woodford, C. Phillips. "Numerical Methods with Worked Examples: Matlab Edition", Springer Science and Business Media
  - b. Steven T. Karris. "Numerical Analysis Using MATLAB and Excel", Orchard Publications
  - c. Steven C. Chapra, Raymond P. Canale. "Numerical methods for engineers", McGraw-Hill Higher Education
  - d. Timothy Sauer. "Numerical analysis", Pearson Education
  - e. Stephen Wolfram. "An elementary introduction to the wolfram language", Wolfram Media, Incorporated.

- f. Cliff Hastings, Kelvin Mischo, Michael Morrison, "Hands-on start to wolfram Mathematics"
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

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**Course code:** PG-305  
**Course title:** Properties of Reservoir Fluids  
**Credit hours:** 3+1  
**Prerequisite:** Applied Thermodynamics

**Specific Objectives of Course:**

To study the properties of reservoir fluids.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand and explain the reservoir fluid properties and examine its impact in reservoir engineering and production problems.
2. Predict the dependency of reservoir fluid properties on pressure, temperature and composition.
3. Compute reservoir fluid properties using correlations, field production data and lab experiments.
4. Derive and use equation of state for predicting the performance of petroleum reservoirs.
5. Use relevant computer software to study fluid behavior.

**Content List**

1. Chemistry of petroleum and review of thermodynamic concepts.
2. Basic concepts of phase behaviour; single, binary and multi-component systems.
3. Equations of State for real fluids.
4. Phase equilibria calculations for reservoir fluids.
5. Sampling procedures: subsurface and surface sampling of reservoir fluids.
6. Determination of reservoir fluid properties from: field data, laboratory analyses, correlations and equations of state.
7. Application of fluid analysis data for use in reservoir and production engineering calculations.
8. Properties of oil field waters.
9. Gas hydrates.
10. Use of existing/available software for phase behaviour calculations.

**Practicum**

1. Determination of flash point of crude oil.
2. Determination of cloud and pour point of crude oil.
3. Determination of density/specific gravity of crude oil.
4. Determination of kinematic viscosity of crude oil.
5. Determination of percentage of sulfur in crude oil.
6. Determination of surface tension of crude oil.
7. Determination of Gas composition / Liquid Composition using Gas Chromatography.
8. Determination of aniline point.
9. Determination of PVT properties.

**Bibliography/References**

1. Books:
    - a. William D. McCain, "The Properties of Petroleum Fluids", Second Edition, Petroleum Pub. Co., 1990.
    - b. Abhijit Y. Dandekar "Petroleum reservoir rock and fluid properties", second edition 2013.
  2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL
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<b>Course code:</b>	PG-306
<b>Course title:</b>	Drilling Engineering - II
<b>Credit hours:</b>	3+1
<b>Prerequisite:</b>	Drilling Engineering - I

**Specific Objectives of Course:**

To study advanced drilling techniques and associated drilling operations.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Formulate well drilling plan taking into consideration the pore pressure and the fracture gradient of the formation.
2. Define the process and importance of cementing and casing.
3. Design operational procedures for cementing.
4. Understand the significance and equipment of well control and establish a procedure for well control strategies.
5. Built foundation in the principles and practices of directional drilling, calculations, and planning for directional and horizontal wells.

**Content List**

1. Analysis of Pore Pressure and Fracture Gradient profiles.



2. Well Planning including Detailed Casing design and Casing Seat Selection.
3. Blow-out prevention: Primary and Secondary Well Control.
4. Well Shut-in policies and details of Well Control Methods.
5. Kill Sheet for Vertical and deviated wells.
6. Well Control Equipment.
7. Cementing
  - a. Primary well / casing cementing.
  - b. Techniques, types of cement and additives.
  - c. Factors considered for the selection of cement type.
  - d. Cementing volumes calculation.
  - e. Single and Two Stage Cementing Methods,
  - f. Squeeze Cementing;
  - g. Basic Cementing Equipment;
  - h. Cement Job Evaluation; Cement Bond Log (CBL) and Variable Density Log (VDL)
8. Mud Logging and Coring methods and equipment.
9. Directional Drilling; Planning the directional well trajectory, kick off and trajectory change, Deflection and survey monitoring tools (MWD and LWD techniques), deviation control and horizontal drilling.
10. Introduction to other drilling techniques; managed pressure drilling, offshore drilling technology etc.
11. Drilling economics: equipment cost and methods of reducing drilling costs.

#### **Practicum**

1. Casing design calculations
2. Case study: Special casing design considerations.
3. Kill Sheet calculations with respect to Drillers method and Engineers method.
4. Cementing calculations.
5. Analysis of MWD / LWD data.

#### **Bibliography/References**

1. Books:
  - a. 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.
  - b. Steve Devereux, "Drilling Technology in Nontechnical Language", Pennwell Publishing, 1999.
  - c. A. T Bourgoyne jr., K. K. Millehim, "Applied Drilling Engineering", ISBN: 1555630014.
  - d. J. L. Lummus, "Drilling Fluids Optimization: A Practical Field Approach", ISBN: 0878143068.

- e. Hussain Rabia, "Oil Well Drilling Engineering, Principles and Practice", ISBN: 0860107140.
- f. Fundamentals of Casing Design, by Hussain Rabia, ISBN: 0860108635
- g. Steve Devereux, "Drilling Technology in Nontechnical Language", Pennwell Publishing; 1999.
- h. Textbook prepared by M-I Drilling Fluids Co., 1998;
- i. Halliburton cementing, casing and cement data tables prepared by Halliburton Company.

- 2. Journals/Periodicals:  
NIL
- 3. World Wide Web:  
NIL

**Course code:** MAN-323  
**Course title:** Environment and Safety Management  
**Credit hours:** 3+0  
**Prerequisite:** Fundamentals of Petroleum Engineering

**Specific Objectives of Course:**

To familiarize the students with environmental hazards, and safety management in petroleum industry.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

- 1. Understand the importance of maintaining a safe workplace.
- 2. Describe and categorize safety standards, policies, and equipment needed to deal with hazardous environment and processes within engineering limits.
- 3. Define and describe the relevant OSHA & EIA regulations.
- 4. Demonstrate an understanding of workplace injury prevention, risk management, and incident investigations.
- 5. Demonstrate knowledge of safety record keeping and management, and the role of the safety manager.

**Content List**

- 1. 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.
- 2. Occupational health and safety administration.

3. Design procedure for operation, maintenance, modification, and emergencies, safety by contractor, accident and incident reporting, investigation and follow-up, and reappraisal of the system.
4. The principles of EIA.
5. Legislation and regulatory aspects of EIA.

### **Practicum**

NIL

### **Bibliography/References**

1. Books:
  - a. Jeremy W. Stranks, "A Manager's Guide to Health and Safety at Work." Seventh Edition, Kogan Page, 2003.
  - b. Phil Hughes, Ed Ferrett, "Introduction to Health and Safety at Work", Fourth Edition, Routledge, 2009
  - c. OSHA Regulations and Guidelines: A Guide for Health Care Providers. ISBN: 9780766804784.
  - d. Larry W. Canter, "Environmental Impact Assessment", ISBN: 0070097674
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
<http://www.osha.gov/pls/publications/publication.html>

**Course code:** CH-325  
**Course title:** Instrumentation and Process Control  
**Credit hours:** 2+1  
**Prerequisite:** Pre-Engineering or Equivalent

### **Specific Objectives of Course:**

To study the instrumentation and controlling of different equipment to be used in Petroleum Industry.

### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Define and describe the basic laws governing the operation of different transducers, relevant circuits and their working.
2. Understand the basic principles and importance of process control in industrial process plants.
3. Calibrate, configure and troubleshooting of different measuring instruments.
4. Develop, construct, and functionally check a process control loop.
5. Understand the use of block diagrams and the mathematical basis for the design of control systems.

## **Content List**

1. Instrumentation
  - a. Principles of measurement of temperature.
  - b. Pressure level, flow, weight Power, speed, position; etc.
  - c. Study of common sensors, transmitters, controllers, actuators, recorders, switches, etc.
  - d. Methodology for calibration.
  - e. Failsafe modes of operation, alarm, trip and interlock system.
  - f. Emergency shut-down systems.
  - g. Fire and gas detection.
  - h. Pressure relief and venting systems.
2. Control Practice
  - a. Terminology signal types and standard ranges interpretation of P and I diagrams; Servo and regulator operation.
  - b. Bias and offset auto/manual optimum settings.
  - c. Ziegler and Nichols formulae.
  - d. Control strategy: Formulation P and I diagrams.
  - e. Control loop elements, Block diagrams.
  - f. Control objectives.
  - g. Industrial Applications.
  - h. Use of feedback, cascade, ratio, feed forward.
  - i. Use of analyzer and chromatographs, Modeling: Lumped parameter models to plant.

## **Practicum**

1. To calibrate the pH probe and pH transmitter.
2. To manually control the pH in the process tank by controlling the flow rates of reagent and effluent.
3. To study the operation of solenoid and servo control valves.
4. To study the operation of Centrifugal pump, Manual valve, Visual flow meter and Servo valve.
5. Calibration of a pressure gauge using a dead weight calibrator.
6. To determine the time constant of a typical Iron-Constantan thermocouple.
7. Preparation of instrument air, free of dust and moisture to control the operation of instruments. The instrument air should be at a regulated pressure.
8. Manual control of process fluid outlet temperature.
9. To calibrate the pressure sensor and pressure transmitter and to investigate the linearity and hysteresis of the sensor/transmitter.
10. Study the K and J type thermocouples
11. Study of control loops
12. Process plant training

## **Bibliography/References**

1. Books:

- a. Howard M. Berlin, Frank C. Getz, "Principles of Electronic Instrumentation and Measurement", Prentice Hall, 1988.
  - b. Chester L. Nachtigal "Instrumentation and control", Wiley, 1990.
  - c. Carlos A. Smith, Armando B. Corripio, "Principles and Practice of Automatic Process Control", ISBN: 0471431907.
  - d. Curtis D. Johnson, "Process Control: Instrumentation Technology", ISBN: 0555009629.
  - e. George. Stephanopoulos, "Chemical Process Control: An Introduction to Theory and Practice", ISBN: 0131286293.
2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL

### **SEMESTER-VI**

<b>Course code:</b>	PG-311
<b>Course title:</b>	Reservoir Geomechanics
<b>Credit hours:</b>	2+0
<b>Prerequisite:</b>	Mechanics of Materials, Petrophysics, Drilling Engineering-I, Applied Geology

#### **Specific Objectives of Course:**

To develop understanding of geo-mechanical aspects in various areas of petroleum engineering.

#### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand stresses around boreholes and in the reservoir, borehole failure, in-situ stress measurement and pore pressure.
2. Describe stress states in reservoirs and their changes over the life of a petroleum reservoir.
3. Compute the stresses and pore pressures from different procedures (correlations, lab measurements etc.).
4. Apply geo-mechanics principles to perform simple calculations related to wellbore stability, hydraulic fracturing etc.

#### **Content List**

1. Fundamentals and experimental rock mechanics
  - a. Stress and strain analysis, mechanical deformation, strength and failure analysis.
2. Subsurface Stresses

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

### Practicum

NIL

### Bibliography/References

1. Books:
  - a. E. Fjær et al, "Petroleum Related Rock Mechanics", Elsevier 2008
  - b. Mark D. Zoback, "Reservoir Geomechanics" 1st Edition.
  - c. Tarek Ahmed, "Reservoir Engineering Handbook" (Fourth Edition) Elsevier ISBN: 978-1-85617-803-7
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

**Course code:** PG-307  
**Course title:** Well Logging  
**Credit hours:** 2+1  
**Prerequisite:** Properties of Reservoir Fluids, Petrophysics

### Specific Objectives of Course:

Learning log interpretation as diagnostic tool in formation evaluation.

### Course Learning Outcomes (CLOs):

After studying this course, the learners will be able to: -

1. Define and describe the basic principles of wireline logging measurements and formation evaluation parameters.
2. Understand the principles and functions of logging tool and design a wireline logging job.

3. Investigate the effects of logging environment on open and cased hole logs and perform required quantitative environmental corrections.
4. Perform Interpretation on well logs to determine the zone of interest(s) and to estimate the hydrocarbon volumes and other formation evaluation parameters in the zone of interest.

#### **Content List**

1. Introduction to wireline logging and formation evaluation parameters.
2. 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.
3. Open Hole Logs
  - a. Classification;
  - b. Data acquisition using Gamma ray log, porosity logs, resistivity logs and magnetic resonance imaging log etc. to identify the rock and calculate its fluid properties.

#### **Practicum**

1. Interpretation of different resistivity profiles.
2. Determination of formation temperature using well log data.
3. Interpretation of resistivity profile.
4. Estimation of formation water resistivity using well log data.
5. Determination of corrected resistivities of invaded and uninvaded zones.
6. Estimating the invasion extent using Tornado charts.
7. Determination of shale volume using well log data.
8. Determination of shale corrected porosity of the rock by using sonic log data.
9. Determination of lithology and porosity of the rocks using various cross plots.

#### **Bibliography/References**

1. Books:
  - a. Bassiouni, Z., "Theory, Measurement, and Interpretation of Well Logs", SPE Textbook Series Vol. 4, Society of Petroleum Engineers Richardson Texas, 1994.
  - b. Rider, M., "The Geological Interpretation of Well Logs", 2nd Edition, Whittles Publishing, 2000.
  - c. George Asquith and Daniel Krygowski, "Basic Well Log Analysis", ISBN: 0891816674
  - d. O. Serra, "Fundamental of Well Log Interpretations:1 The acquisition of Logging data", ISBN: 044455341X.
  - e. Zaki Bassiouni, "Theory, Measurement and Interpretation of Well Logs", ISBN: 1555630561.

2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

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<b>Course code:</b>	PG-308
<b>Course title:</b>	Reservoir Engineering - I
<b>Credit hours:</b>	3+1
<b>Prerequisite:</b>	Petrophysics, Properties of Reservoir Fluids

**Specific Objectives of Course:**

To introduce the principles of Reservoir Engineering.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Discuss the fundamentals of reservoir engineering.
2. Distinguish between various reservoir flow systems and geometry.
3. Derive and apply different flow equations (Darcy equation, diffusivity equation, frontal advance, etc.).
4. Interpret the hydrocarbon recoveries from reservoirs under derive mechanisms through both volumetric and material balance methods.
5. Quantify well-bore damage, pressure gradient, relative permeability, flowing bottom-hole pressure, gas compressibility and pseudo-reduced compressibility from different methods.
6. Understand the concepts of water/gas coning and fingering, its predictions and remedial treatments.

**Content List**

1. Fundamentals of reservoirs engineering.
  - a. Classification of reservoir fluid flow systems.
  - b. Darcy's law for fluid flow through porous media,
  - c. Different forms of Darcy's law,
  - d. Steady state and unsteady state flow,
2. Basic flow equations,
  - a. Continuity equation and its derivation.
  - b. Diffusivity equation and its different forms.
3. Pressure distribution and pressure gradient for linear, radial, compressible, slightly compressible and incompressible steady state and unsteady state flow conditions.
4. Average permeability calculations for beds in series and beds in parallel for linear and radial reservoir geometry.
5. Determination of average pressure in radial flow system, Readjustment time, Productivity index, Specific productivity index



and injectivity index, Relationship between well-bore radius and flow rate in radial flow system.

6. Volumetric evaluation of Hydrocarbon in place and empirical reserve estimates.
7. Different types of reservoir drive mechanism.

### **Practicum**

1. Determination of pressure gradient (gas, oil and water) from the well test data (such as MDT).
2. Determination of OIP with the help of GOC and WOC to find the value of oil thickness zone.
3. Determination of gas compressibility and pseudo-reduced compressibility from a gas reservoir.
4. Construction of relative permeability curves from steady state test data.
5. Calculation of velocities and fluid potential for steady state linear flow of incompressible, slightly compressible and compressible fluid using different flow equations
6. Understanding the pressure profile for radial flow of incompressible, slightly compressible and compressible fluid flow in the reservoir.
7. Working on exact solution of compressible fluid flow in porous media.
8. Understanding the well bore damage and its quantitative effect on porous media flow equations.
9. Working on the use of different solutions of diffusivity solutions
10. Working on different means to estimate the flowing bottom hole pressure.
11. Reservoir Estimation and Average Reservoir Pressure calculation using MBE for different reservoir types
12. Performance prediction using MBE for various reservoir drives
13. Water and gas coning calculations
14. Water and gas fingering predictions.

### **Bibliography/References**

1. Books:
  - a. Mark P. Walsh and Larry W. Lake, "A Generalized Approach to Primary Hydrocarbon Recovery", Volume 4, Elsevier, 2003.
  - b. Tarek Ahmed, "Reservoir Engineering Handbook", Third Edition, Elsevier, 2006.
  - c. Brian F. Towle, "Fundamental Principles of Reservoir Engineering"
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

**Course code:** PG-309  
**Course title:** Petroleum Production Engineering - I  
**Credit hours:** 3+1  
**Prerequisite:** Fundamentals of Petroleum Engineering, Reservoir Fluid properties

**Specific Objectives of Course:**

To familiarize the students with surface facilities and subsurface equipment for production optimization.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Describe the basic components and methods used to complete and produce oil and gas wells.
2. Analyze one and two phase flow behavior and flow regimes through different flow models.
3. Define and describe the concepts of IPR and TPR and apply them to estimate and predict the deliverability of oil/gas wells.
4. Apply NODAL Analysis to estimate fluid pressure losses through components of a basic petroleum production system.
5. Perform production forecast using different tools and software.
6. Estimates choke performance.

**Content List**

1. Introduction to Petroleum Production system;
2. Components and working principles,
3. IPR for different types of reservoir
  - a. Inflow performance Relationship (IPR) models; Straight line and curve IPR,
  - b. Time dependency of the IPR models.
4. Vertical lift performance (VLP) of oil and gas wells;
5. Single phase and multi-phase well flow models; Homogeneous and separated flow models, mechanistic and empirical models,
6. Pressure traverse and pressure drop estimation,
7. Estimating the choke performance; Single phase, multiphase, critical and sub critical flow models,
8. Deliverability of oil and gas wells; Principle of system analysis (NODAL™ Analysis) with simplified well configuration, Use of IPR and TPR (Tubing Performance Relationship),
9. Forecast of Well production; forecasting the behavior of and oil or gas well using the principle of Nodal analysis.

**Practicum**

1. Determination of pressure losses during fluid flow in the reservoir.
2. Establishing different inflow performance relationships.

3. Determination of vertical lift performance of a well using choke and bottom-hole parameters.
4. Introduction to different software for production system analysis including Nodal Analysis.
5. Production forecasting using different tools.
6. Determination of reservoir/bottom-hole parameters using surface production data.
7. Sensitivity analysis of various parameters to optimize the deliverability of different components of the production system

### **Bibliography/References**

1. Books:
  - a. Boyun Guo, William C. Lyons and Ali Ghalambor, "Petroleum Production Engineering-A computer assisted approach", Publisher: Elsevier Science and Technology Books.
  - b. Michael J. Economides, A. Daniel Hill, Christine Ehlig-Economides and Ding Zhu, "Petroleum Production Systems", 2nd Edition, Published by Prentice Hall.
  - c. H. Dale Beggs, "Production Optimization using NODALTM Analysis", published by OGCL, Inc., Petroskills, Tulsa Oklahoma.
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

<b>Course code:</b>	CH-326
<b>Course title:</b>	Petroleum Refinery Engineering
<b>Credit hours:</b>	3+1
<b>Prerequisite:</b>	Properties of Reservoir Fluids

### **Specific Objectives of Course:**

To enable the students to understand refinery environment.

### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Define and describe the crude oil composition, refinery products and processes.
2. Design and conduct the laboratory tests for determining the properties of refined product.
3. Illustrate and compare the procedure for separation and distillation of crude oil.

### **Content List**

1. Crude Oils
  - a. Crude Oils Composition,
  - b. Types of crude oil,
  - c. Types of Processing for crude oil,
  - d. Separation and distillation.
2. Petroleum and Fuels
  - a. Petroleum Processing.
  - b. Separation,
  - c. Natural gas, composition,
  - d. stripping at the well head, stripping at the gathering station and Natural gasoline.
3. Products of Primary Distillation
  - a. Separation by vacuum distillation,
  - b. Indicative yield from primary distillation,
  - c. separation by absorption,
  - d. Petroleum Processing conversion processes,
  - e. cracking and reforming,
  - f. Products Treatments and Separation of olefins.
4. Polymeric Materials from Petroleum.
5. Inorganic Chemicals from Petroleum.
6. Synthetic Fuels.
7. Synthetic Detergents.

### **Practicum**

1. Effect of temperature on viscosity by using Viscometer.
2. Determine the Calorific value of given sample of Fuel
3. Determine the Flash Point of different sample.
4. Determine the Aniline Point of the given Sample.
5. Determine the API and Specific gravity of given sample
6. Determine the color of petroleum product by ASTM colorimeter
7. Determine the ASTM distillation of petroleum products
8. Determine the fire point of given sample of fuel using open cup method
9. Determine Cloud and Pour Point of given Sample

### **Bibliography/References**

1. Books:
  - a. William A. and Stevens, Donald Gruse, "Chemical Technology of Petroleum", McGraw-Hill
  - b. W. L. Nelson. "Petroleum Refinery Engineering", McGraw-Hill
  - c. Lewis F. Hatch and Sami Matar. "Chemistry of Petrochemical Processes", Gulf Professional Publishing.
2. Journals/Periodicals:  
NIL

- World Wide Web:  
NIL
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### SEMESTER-VII

<b>Course code:</b>	PG-410
<b>Course title:</b>	Natural Gas Engineering
<b>Credit hours:</b>	2+1
<b>Prerequisite:</b>	Mechanics of Materials, Properties of Reservoir Fluids

#### **Specific Objectives of Course:**

To study gas measurement, processing, transmission and distribution.

#### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

- Describe natural gas composition, its properties, ideal and real gas behavior.
- Understand the natural gas processing and its importance.
- Analyze gas flow performance, metering, transmission and distribution, its problems and possible solutions.
- Perform natural gas flow and compression calculations.

#### **Content List**

- Introduction to natural gas industry
- Natural gas properties
- Flow and compression calculations
- Sweetening and dehydration of natural gas
- Natural Gas commissioning, transmission and distribution
- Pipe line welding techniques
- Testing and welding defects
- Gas flow measurements
- Introduction to LPG and LNG
- Unaccounted for gas

#### **Practicum**

- Determination of heating values and lower explosive limits.
- Flowing calculations in high pressure piping with different formulas.
- Equivalent lengths of complex pipeline systems.
- Looping line problems.
- High pressure pipeline wall thickness and pipe grades.
- Define meter flow calculations by AGA Report 3 Formula.
- Demonstration of positive displacement meters.
- Study and deviation of Ideal gas law.
- Determination of Z-factor in different cases.

## **Bibliography/References**

1. Books:
    - a. William C. Lyons, Gary J Plisga, "Standard Handbook Of Petroleum And Natural Gas Engineering", Volume 1, Gulf Professional Publishing, 1996.
    - b. Donald L. Katz, R. L. Lee, "Natural Gas Engineering Production And Storage", McGraw-Hill New York, 1990.
    - c. John M. Campbell, "Gas Conditioning and Processing", ASIN: B000UMK60W.
    - d. James W. Amyx, "Petroleum Reservoir Engineering Physical Properties", ISBN: 0070016003.
  2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL
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<b>Course code:</b>	MAN-424
<b>Course title:</b>	Project Planning and Management
<b>Credit hours:</b>	2+1
<b>Prerequisite:</b>	Technical Writing and Presentation Skills

### **Specific Objectives of Course:**

To inculcate in students the knowledge of planning in projects and management.

### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Define and describe project and management.
2. Select, plan, develop, execute, control and close the project effectively.
3. Conduct project planning activities that accurately forecast project costs, timelines, and quality.
4. Apply different management techniques for the successful completion of project.
5. Demonstrate a strong working knowledge of ethics and professional responsibility.
6. Use relevant software.

### **Content List**

1. Introduction, project management context; project management.
2. Processes integration management; project plan development, project plan development, project plan execution, overall change control.
3. Scope management; initiation, scope planning, scope definition, scope verification, scope change control.

4. Time management; activity definition, activity sequencing, activity duration estimation, schedule development, schedule control.
5. Cost management; quality planning, staff acquisition, team development.
6. Communications management; communications planning, information distribution, performance reporting, administrative closure.
7. Risk management; risk identification, risk quantification, risk response development, risk response control.
8. Procurement management; procurement planning, solicitation planning, source selection, contract administration, contract close-out.
9. Closing; administrative closure, contract close-out, lessons learnt.

**Practicum**

1. computing project management software,
2. PERT,
3. Gantt chart/Network,
4. CPM,
5. S Curves etc.
6. CPM, Statistical techniques.

**Bibliography/References**

1. Books:
  - a. Kim Heldman, "Project Management Professional Exam Study Guide", 5th Edition, John Wiley & Sons, 2009.
  - b. Garold D. Oberlender, "Project Management for Engineering and Construction", Third Edition, McGraw-Hill Education, 2014.
  - c. A guide to the Project Management Body of Knowledge, by Project Management Institute (PMI) standards committee, ISBN: 1880410133
  - d. S. A. Kelkar, "Software Project Management, A Concise Study" , Prentice Hall of India, ISBN: 8120336720.
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

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<b>Course code:</b>	PG-411
<b>Course title:</b>	Well Testing
<b>Credit hours:</b>	3+1
<b>Prerequisite:</b>	Petrophysics, Reservoir Engineering

**Specific Objectives of Course:**

To acquire and analyze flow rate and pressure data for reservoir diagnostics..

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Define and develop equations for fluid flow in porous media and to solve the governing equations to determine reservoir properties by well testing.
2. Discuss various techniques of pressure transient and well deliverability testing with application.
3. Design and execute a well test and interpret well test data to estimate reservoir and well bore properties.
4. Justify the limitations of well test interpretation.
5. Use relevant software for analysis and estimations.

**Content List**

1. Fundamentals of fluid flow in porous media.
2. Drill-stem testing and analysis.
3. Principle of superposition.
4. Design and implementation of well tests.
5. Introduction to pressure transient tests: draw-down and build-up test analysis.
6. Well test analysis by use of type curves and derivative curves.
7. Analysis of pressure buildup tests distorted by phase redistribution.
8. Well test interpretation in hydraulically fractured wells.
9. Interpretation of well test data in naturally fractured reservoirs.
10. Gas Well Testing
  - a. Deliverability testing of gas wells: Fundamental equations in deliverability testing, flow after flow test, isochronal test and modified isochronal test.
  - b. Use of pseudo pressure in deliverability testing and real gas pseudo pressure analysis.
  - c. Guide lines for gas well testing.
11. Problems in gas well testing
  - a. Liquid loading.
  - b. Use of computer in Gas Reserves estimation and well test analysis.
12. Multiple well test: Interference and pulse test.

**Practicum**

1. Numerical Application of flow and build-up test.
2. Multi-rate test
3. Type and derivative curve matching.
4. Interpretation of tests using software.
5. Design of well test.



### **Bibliography/References**

1. Books:
    - a. John Lee, "Well Testing", Volume 1, SPE Textbook Series, 1982.
    - b. G.Bourdet, "Well Testing: Interpretation methods", IFP, 1998
    - c. M. A. Sabet, "Well Test Analysis"
    - d. Robert C. Earlougher Jr , "Advances in Well Test Analysis", ISBN: 0895202042.
  2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL
- 

<b>Course code:</b>	PG-412
<b>Course title:</b>	Petroleum Production Engineering - II
<b>Credit hours:</b>	3+1
<b>Prerequisite:</b>	Petroleum Production Engineering – I

### **Specific Objectives of Course:**

To develop understanding of Problem well diagnostics and remedial measures.

### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Identify the methods, tools and designing parameters required for well completion.
2. Analyze and predict well performance using different techniques.
3. Investigate the causes of low well productivity and preventive strategies, characterize near wellbore damage and select an appropriate stimulation technique.
4. Analyze and optimize artificial lift methods.

### **Content List**

1. Well Completion; Types and methods, Well completion equipment and various completion designs.
2. Causes of low well-productivity; Effects of Reservoir / wellbore dominated factors and mechanical failures.
3. Well Diagnostics; Near wellbore damage characterization; Formation damage - causes and prevention.
4. Problem-well diagnostics and remedies
5. Stimulation Techniques
  - a. Introduction to Acidizing and its designing.
  - b. Introduction to Hydraulic Fracturing, design and calculations.
6. Introduction to Artificial Lift Methods; Gas Lift, Electrical Submersible Pump, Sucker Rod Pump, jet pumps etc.

### Practicum

1. Interpretation of Production Logging data for well diagnostics.
2. Determination of productivity ratio of a reservoir stimulation job.
3. Well hydraulics calculations for an anticipated stimulation job.
4. Hydraulic fracture design and its modelling.
5. Acid fracturing job design and its modelling.
6. Graphical determination of the point of gas injection in gas lifts designing.
7. Valve spacing design for gas lifts installation.
8. ESP Design and Analysis.

### Bibliography/References

1. Books:
  - a. Boyun Guo, William C. Lyons and Ali Ghalambor, "Petroleum Production Engineering-A computer assisted approach", Publisher: Elsevier Science and Technology Books.
  - b. Michael J. Economides, A. Daniel Hill, Christine Ehlig-Economides and Ding Zhu, "Petroleum Production Systems", 2nd Edition, Published by Prentice Hall.
  - c. H. Dale Beggs, "Production Optimization using NODALTM Analysis", published by OGCL, Inc., Petroskills, Tulsa Oklahoma
  - d. Thomas O. Allen and Alan P. Roberts, "Production Operations", Vol I and II, ASIN: B007OAP64O.
  - e. T. E. W Nind, "Principles of Oil Well Production", ISBN: 0070465762.
  - f. Chi U. Ikoku, "Natural Gas Production Engineering" ISBN: 0894646397.
  - g. Michael Golan and Curtis Whitson, "Well Performance", ISBN: 9027722838.
  - h. G. V. Chillingarian, J. O. Robertson, "Surface Operation in Petroleum Production", ISBN: 0444424733.
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

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<b>Course code:</b>	PG-416				
<b>Course title:</b>	Reservoir Simulation				
<b>Credit hours:</b>	3+1				
<b>Prerequisite:</b>	Applied	Numerical	Methods,	Reservoir	
	Engineering				

**Specific Objectives of Course:**

To develop basic understanding of hydrocarbon-reservoir performance under various operating conditions by using simulation software.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Define the basic concepts of reservoir simulation.
2. Formulate fluid flow in porous media and to solve the governing equations, numerically using finite difference methods.
3. Apply the concepts of reservoir engineering and reservoir simulation for petroleum field development through relevant software.

**Content List**

1. Introduction to the concepts of reservoir simulation, its advantages and limitations.
2. Revision of basic reservoir engineering concepts, reservoir fluid and rock properties and basic mathematical concepts.
3. Formulation of basic equations for single-phase flow in porous media, finite difference approximation to flow equations, stability and error analysis.
4. Well representation in simulators, solution of linear difference equations applicable to the reservoir using direct and iterative methods.

**Practicum**

1. Software Applications: Use of a reservoir simulator, input data and data file preparation, fine tuning for history matching and performance prediction.
2. Class projects using software application.

**Bibliography/References**

1. Books:
  - a. Turgay Ertekin, Jamal H. Abou-Kassem, Gregory R. King, "Basic Applied Reservoir Simulation", Vol. 7, Society of Petroleum Engineers Richardson Texas, 2001.
  - b. M. R. Carlson, "Practical Reservoir Simulation", Edition illustrated, Pennwell Books-Tulsa, Oklahoma, 2003.
  - c. Calvin C. Mattax and Robert L. Dalton, "Reservoir Simulation", Vol. 13, Society of Petroleum Engineers Richardson Texas, 1990.
  - d. Donald W. Peaceman, "Fundamentals of Numerical Reservoir Simulation", ISBN: 0444552987
  - e. Calvin, C. Mattax, "Reservoir Simulation", ISBN: 1555630286.
  - f. Henry B. Crichlow, "Modern Reservoir Engineering: A Simulation Approach" ISBN: 0135974682.

- g. John R. Fanchi, "Principles of Applied Reservoir Simulation", ISBN: 0750679336
  - h. Gordon W. Thomas , "Principles of Hydrocarbon Reservoir Simulation", ISBN: 0137111770
- 2. Journals/Periodicals:  
NIL
  - 3. World Wide Web:  
NIL
- 

### **SEMESTER-VIII**

**Course code:** PG-414  
**Course title:** Final Year Project  
**Credit hours:** 0+6  
**Prerequisite:** Complete Course Work

**Specific Objectives of Course:**

To create research abilities in student through research work.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

- 1. Design a complete project includes; identification, analysis, preparation of methodology, execution, and consideration of alternative options both technically and economically feasible.
- 2. Integrate various components of petroleum engineering with possible application of computer techniques.
- 3. Enable students to comprehend technical contents.
- 4. Develop skills in oral and written communication.
- 5. Interact with other students to practice teamwork and communication skills.

**Content List**

Experimental and/or theoretical approaches with possible application of computer techniques to integrate various components of the curriculum in a comprehensive engineering design experience. Design of a complete project including identification of a problem, formulation of design, preparation of specifications, and consideration of alternative feasible solutions both technically and economically.

**Practicum**

NIL

**Bibliography/References**

- 1. Books:  
NIL

2. Journals/Periodicals:  
NIL
  3. World Wide Web:  
NIL
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**Course code:** PG-417  
**Course title:** Petroleum Economics  
**Credit hours:** 2+0  
**Prerequisite:** Reservoir Engineering - I

**Specific Objectives of Course:**

To study the feasibility and viability of petroleum projects.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Understand and use the fundamentals of economic principles in Petroleum Industry.
2. Apply engineering economics techniques to evaluate feasibility of proposed exploration, development and production projects.
3. Estimate the reserves and forecast capital investment, operating cost and cash flows.
4. Develop balance sheet and income statement.

**Content List**

1. Introduction to the standards and practices of economic analysis in the petroleum industry.
2. Brief review of the principles of economic evaluation.
3. ROR and NPV analysis.
4. Definition of risk and uncertainty, decision, analysis, decision tree analysis and estimation of future money values.
5. Typical decision making situations including risk analysis and EMV calculations and alternative reservoir depletion schemes.
6. Analysis involves reserve estimation and forecasting of capital investment, operating cost and manpower requirement.
7. Petroleum taxation regulations (policies and laws), profitability criteria, cut off criteria unit operations, SPE-Petroleum resource and reserve classification.
8. Before tax cash flow models, after cash flow models.
9. Capital budgeting techniques.
10. Investment selection decision making.
11. Evaluation nomenclature, time value of money, basic interest equations, present and net present value, ABC transaction, payout, payback time and rate of return.
12. Engineering economics, factors and their uses.
13. Evaluation of alternatives.

14. Depreciation, depletion and corporate taxes.
15. Cash flow analysis.
16. Application of the principles of engineering economics to exploration, drilling, and production operations.

**Practicum**

NIL

**Bibliography/References**

1. Books:
  - a. H. K. Abd-El-Aal, Bakr A. Bakr, M. A. Al-Sahlawi, "Petroleum Economics and Engineering", 2<sup>nd</sup> Edition, M. Dekker, 1992.
  - b. Karl E. Case, Ray C. Case, Rat C. Fair, "Principles of Economics", 6<sup>th</sup> Edition, Pearson Education, 2001
  - c. Anthony Tarquin, Leland Blank, "Engineering Economy", ISBN: 0073376302
  - d. Richard D. Seba, "Economics of Worldwide Petroleum Production", ISBN: 093097221X.
  - e. John R. Schuyler, "Decision Analysis for Petroleum Exploration", ISBN: 0966440110.
  - f. M. A. Mian, Mohammad A. Mian, "Project Economics and Decision Analysis", ISBN: 0878148191.
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

**Course code:** PG-415  
**Course title:** Principles of Enhanced Oil Recovery  
**Credit hours:** 3+1  
**Prerequisite:** Reservoir Engineering – I

**Specific Objectives of Course:**

To enable the students to understand how to maximize recovery by applying external energy sources.

**Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Describe and discuss the fundamentals of water and immiscible gas injection and related selection criteria.
2. Explain the physical mechanisms of Enhanced Oil Recovery methods.
3. Design and conduct experiments/mathematical models to evaluate the feasibility of proposed flooding project.

4. Compute the microscopic and macroscopic efficiencies of the flooding project.
5. Design typical EOR projects workflow and related screening criteria and compute economics.
6. Use relevant software for analysis and estimations.

#### **Content List**

1. Basic concepts of EOR: Linear, two- and three-dimensional displacements.
2. The role of reservoir geology in the design and operations.
3. Microscopic efficiency of linear immiscible displacement.
4. Areal and vertical displacement efficiency in 2-D and 3-D systems.
5. Water Flooding: Selection criteria, displacement theories and performance calculations.
6. Selection and efficiency of various flood patterns
7. Practical considerations for waterflood design.
8. Immiscible Displacement by Gas Injection: Surface installations; compression and treatment methods.
9. Special applications of gas injection.
10. Thermal Recovery Methods: steam and hot water displacement.
11. In-situ combustion.
12. Miscible Flooding: Thermodynamic miscibility, ternary diagram, first and multiple contact miscibilities.
13. Carbon dioxide, nitrogen and water alternating gas flooding.
14. Chemical injection: polymers, misceller polymer, alkaline and surfactants.

#### **Practicum**

1. Projects: Solution of EOR problems; development of computer algorithms and example calculations
2. Laboratory analysis for understanding the in-situ combustion process for heavy oil.
3. To study the steams flooding for enhance oil recovery from heavy oil reservoir.
4. Study on polymer flooding for improving oil recovery.
5. Study on surface/polymer or miscible polymer flooding.
6. To study the water injection process for improving oil recovery from depleted oil reservoir.
7. To study the air injection process and its mechanism and description.
8. To demonstrate low pressure gas injection immiscible flooding.
9. To determine the primary studies fluid evaluation and injection efficiency.
10. To demonstrate the high-pressure gas injection per EOR depleted oil reservoir.

11. To determine the major factors involved for preparing fields pilot project for water injection process.
12. To demonstrate an alkaline flooding or caustic flooding
13. To demonstrate low pressure gas injection immiscible flooding process.
14. Carbon dioxide (CO<sub>2</sub>) flooding for heavy oil reservoir.

### **Bibliography/References**

1. Books:
  - a. Tarek Ahmed, "Reservoir Engineering Handbook", Third Edition, Elsevier, 2006.
  - b. Don W. Green and G. Paul Willhite, "Enhanced Oil Recovery", 22nd Edition, Volume 6, Society of Petroleum Engineers Richardson Texas, 1998.
  - c. Larry W. Lake, "Enhanced Oil Recovery", Society of Petroleum Engineers Richardson Texas, 2010.
  - d. Marcel Latil, "Enhanced oil Recovery" ISBN: 0872017753
  - e. Rafael Sandrea, Ralph Nielsen, "Dynamics of Petroleum Reservoirs under Gas Injection", ISBN: 0872012190
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

**Course code:** PG-413  
**Course title:** Reservoir Engineering - II  
**Credit hours:** 3+1  
**Prerequisite:** Reservoir Engineering - I

### **Specific Objectives of Course:**

Study of advanced concepts of Reservoir Engineering.

### **Course Learning Outcomes (CLOs):**

After studying this course, the learners will be able to: -

1. Describe the basics of Gas reservoir engineering terminologies.
2. Compute the recoveries from a natural gas reservoir through volumetric and material balance methods for closed and water influx reservoir.
3. Understand the fundamentals of gas-condensate reservoir and apply different techniques to estimate its reserves.
4. Estimate formation evaluation parameters for gas and gas condensate reservoirs through well testing.
5. Use relevant software for analysis and estimations.



### **Content List**

1. Material Balance Equation
  - a. Derivation and applications.
  - b. Productivity index, specific productivity index, and injectivity index.
  - c. Relationship between well-bore radius and flow rate in radial flow system.
  - d. Theory of Frontal Advance.
  - e. Performance Calculation for depletion drive and water drive reservoirs using different methods.
2. Water/gas Coning and fingering and prediction by different methods for different reservoirs (Homogeneous, Isotropic and Fractured).
3. Remedial treatments for coning and fingering.
4. Gas Condensate Reservoirs
  - a. Reservoir types defined with reference to phase diagrams,
  - b. Calculation of original gas and condensate in place for volumetric reservoirs.
  - c. Reserves calculations with and without compositional data.
  - d. Well Testing and sampling, material balance and performance of volumetric retrograde gas condensate reservoirs.
5. Overall reservoir management and exploitation study.

### **Practicum**

1. Class assignment.
2. Presentations.
3. Use of software

### **Bibliography/References**

1. Books:
  - a. Chi U. Ikoju, "Natural Gas Production Engineering", ISBN: 0894646397.
  - b. Dale Beggs, "Gas Production Operations", ASIN: B001O78FVY.
  - c. David A. T. Donohue, "Gas Well testing: theory, practice and regulation", ISBN: 9780934634106
  - d. Amanat Chaudhry, "Oil Well Testing Handbook", ISBN: 0750677066.
  - e. W. John Lee, "Gas Reservoir Engineering", ISBN: 1555630731. .
2. Journals/Periodicals:  
NIL
3. World Wide Web:  
NIL

## **ME/MSc PROGRAM IN PETROLEUM/PETROLEUM & GAS ENGINEERING**

### **INTRODUCTION**

Energy is a key component in our everyday lives. A secure energy future requires a balance between environmental impact and affordable supply. Petroleum engineers can address and solve important issues that will lead to energy security and thus petroleum engineers with graduate degrees are highly sought after by petroleum industry world-wide.

Petroleum engineers have a future full of challenges and opportunities. They must develop and apply new technology to recover hydrocarbons from shale, tight sands, and onshore and offshore oil and gas fields. They must also devise new techniques to recover hydrocarbon left in the ground after application of conventional producing techniques.

### **OBJECTIVES**

The objective of this program is to educate graduates to solve problems related to exploring and recovering subsurface hydrocarbon resources. The program allows students to take courses in a broad range of areas, including drilling engineering, formulation evaluation, petroleum economics, production engineering, and reservoir engineering.

At the end of the course of studies, the students will be able to analyse hydrocarbon deposits both for quantity of reserves and production capacity, and will identify the best strategies for producing oil and/or natural gas based not only on technical feasibility but also economic and environmental sustainability.

### **ELIGIBILITY CRITERIA**

Graduates with BE/BS/BSc degree in the field of Petroleum Engineering, Chemical Engineering Geological Engineering, Mechanical Engineering and other relevant engineering disciplines are eligible to apply for admission.

Candidates accepted for M.Engg/MSc. programme in petroleum engineering possessing engineering degree other than petroleum engineering, will be allowed to make up deficiencies by taking up to six (06) credit hours of non-credit courses. This will be counted as part of minimum requirements to the M.Engg. programme.

### **DESIGN OF COURSES**

The courses are designed by taking into account the demands of National and International petroleum industry. The leading universities courses were considered in designing of the course content.

## FRAMEWORK FOR ME/MSc PROGRAM IN PETROLEUM ENGINEERING

### GROUP A (Core Courses)

S. No.	Subjects	Credit Hours
1.	Enhanced Oil Recovery	3
2.	Advanced Well Testing	3
3.	Advanced Petroleum Production Engineering	3
4.	Advanced Drilling Engineering	3
5.	Advanced Reservoir Engineering	3
6.	Applied Reservoir Simulation	3
7.	Advanced Well Log Interpretation	3
8.	Unconventional Reservoirs	3

### GROUP B (Elective Courses)

S. No.	Subjects	Credit Hours
1.	Drilling Fluid Hydraulics / Engineering	3
2.	Horizontal Well Technology	3
3.	Underbalanced and Managed Pressure Drilling	3
4.	Offshore Drilling	3
5.	Well Control	3
6.	Reservoir Engineering Management	3
7.	Petroleum Resources and Reserves Estimation	3
8.	Naturally Fractured Reservoirs	3
9.	Mechanics of Gas Flow in Porous Media	3
10.	Carbonate Reservoir Characterization	3
11.	Advanced Reservoir Simulation	3
12.	Well Stimulation Design	3
13.	Production Optimization	3
14.	Petroleum Production Operations	3
15.	Natural Gas Processing	3
16.	Artificial Lift Methods	3
17.	Petroleum Economics	3
18.	Advanced Petrophysics and Well Logging	3
19.	Applied Borehole Geomechanics	3
20.	Advanced Petroleum Geology	3
21.	Seismic Data Acquisition, Processing and Interpretation	3
22.	Applied Mathematics in Petroleum Engineering	3
23.	Health, Safety and Environment	3
24.	Thermodynamics and Phase Behaviour of Hydrocarbon Systems	3

**RESEARCH THESIS**

1.	Thesis / Dissertation	6
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**NOTE:**

1. Every student must take minimum 12 credit hours of course work from Group A.
2. A minimum of 30 Credit Hours need to be completed in the either of the two streams: -
  - a. MSc / ME Petroleum Engineering includes a minimum of 24 Credit Hours of Course-Work + 06 Credit Hours for Thesis or,
  - b. MSc / MEngg / ME Petroleum Engineering, the candidates will need to complete minimum 30 credit hours of course work.
3. These courses are designed of postgraduate level.

**SCHEME OF STUDIES FOR ME/MSc PROGRAM IN PETROLEUM ENGINEERING**

The Master's degree program in Petroleum Engineering/Petroleum & Natural Gas Engineering shall be of thirty (30) credit hours including dissertation and Independent study project(ISP) where total credits hours for course work are proportionally reduced.

All courses shall be equivalent to three (03) credits hours except dissertation and Independent Study Project. The ISP shall be equivalent to six (06) credits hours and shall be required to be completed within two semesters, with three (03) credits hours enrolled in each of the two semesters. The dissertation shall be equivalent to nine (09) credits hours and shall be required to be completed within two semesters. A student may earn the degree either completing twenty-four (24) credits in taught courses and six (06) credits through Independent Study Project, or by completing twenty-one (21) credits in taught courses and nine (09) credits in dissertation.

## DETAIL OF EACH COURSE FOR M.E. / M.SC. IN PETROLEUM ENGINEERING

### I. Compulsory or Core Courses (Group - A)

**PET-501            ENHANCED OIL RECOVERY            Credit Hours: 3**

#### **Course Outline**

1. Enhanced Oil Recovery Processes: General review of process description, recovery efficiency.
2. The Oil Resource for EOR Processes: Waterflooded reservoirs, heavy oil reservoirs. Miscible Displacement, dispersion, diffusion, fingering.
3. Mechanics for Mobilization and Displacement of Residual Oil, Miscible processes, immiscible processes.
4. Chemical Flooding Processes.
5. Carbon Dioxide Miscible Recovery Process.
6. Thermal Recovery Processes.

#### **Recommended Books**

1. Enhanced oil Recovery by Marcel Latil, ISBN: 0872017753.
2. Enhanced Oil Recovery by Don W. Green and G. Paul Willhite, ISBN: 1555630774.
3. Enhanced Oil Recovery by Larry W. Lake, ISBN: 1555633056.
4. Water Flooding by Don W. Green, G. Paul Willhite ISBN: 1555630057.
5. Dynamics of Petroleum Reservoirs under Gas Injection, by Rafael Andrea, Ralph Nielsen, ISBN: 0872012190.

**PET-502            ADVANCED WELL TESTING            Credit Hours: 3**

#### **Course Outline**

1. **Introduction:** Introduction to transient pressure testing, basic concepts in well testing, Diffusivity Equation and its boundary conditions, Exponential integral (line source) solution and its logarithmic approximation. Principle of superposition. Bounded circular reservoir solution. Depth of investigation,
2. **General Testing Methods:** Pressure drawdown and reservoir limit testing in new and mature reservoirs. Pressure Buildup testing. Determination of permeability, reservoir pressure, skin factor, well efficiency. Considerations in well test design. Pressure derivative approach and direct synthesis without type curves (TDS). Two Rate Testing, Multirate Tests. Multiwell Testing – Interference Test Analysis, Pulse Testing.
3. **Injection Well Testing:** Pressure Fall-Off test in injection wells. Step-Rate test.

- 4. Effect of Reservoir Heterogeneities on Pressure Behavior:** Linear discontinuity, (sealing / non-sealing faults and barriers), permeability anisotropy, Composite systems, layered reservoirs (with cross flow). Naturally fractured reservoirs. Determining fault conductivity from well tests, wells near multiple boundaries. Average reservoir pressure determination of the Hydraulically Fractured Wells. Determining hydraulic fracture orientation from wellbore. Limited Entry Hydraulic Fractures Testing of the heterogeneous reservoir. Software assisted assignments and numerical well test modeling using numerical software.

**Recommended Books**

1. Pressure Transient Testing by John Lee, ISBN: 1555630995.
2. Well Test Analysis by M. A. Sabet. ISBN: 087201584X.
3. Advances in Well Test Analysis by Robert C. Earlougher Jr, ISBN: 0895202042.
4. Well Testing by John Lee, ISBN: 0895203170.
5. Oil Well Testing Handbook by Amanat Chaudhary, ISBN: 0750677066.
6. Gas Reservoir Engineering by W. John Lee, ISBN: 1555630731.
7. Gas Well Testing Handbook by Amanat Chaudhry, ISBN: 0750677066

**PET-503    ADVANCED PETROLEUM PRODUCTION ENGINEERING**  
**Credit Hours: 3**

**Course Outline**

1. Flowing well performance of oil and gas wells (vertical and horizontal), including single and multiphase flow, well deliverability.
2. Problem well diagnostics with production logging and improved well productivity through well stimulation techniques and other remedies.
3. Production system analysis and production optimization using Nodal Analysis approach.
4. Use of modern tools and methods for safe, efficient and economical well intervention.

**Recommended Books**

1. Petroleum Production Systems by Michael J. Economides, A. Daniel Hill, ISBN: 013658683X.
2. Production Optimization using Nodal™ Analysis by H. Dale Beggs, ASIN: B001QGWNOS.
3. Petroleum Production Engineering: A computer Assisted Approach by Boyun Gue, William C. Lyons and Ali Ghalambor ISBN: 0750682701.

4. Production Operations by Thomas O. Allen and Alan P. Roberts, ASIN: B007OAP64O.
5. Principles of Oil Well Production by T. E. W Nind, ISBN: 0070465762.
6. Natural Gas Production Engineering by Chi U. Ikoju, ISBN: 0894646397.
7. Introduction to Petroleum Production; Volume I & II by D. R. Skinner, ISBN: 0872017672.
8. Well Performance by Michael Golan and Curtis Whitson, ISBN: 9027722838.
9. Surface Operation in Petroleum Production by G. V. Chillingarian, J. O. Robertson, ISBN: 0444424733.

**PET-504    ADVANCED DRILLING ENGINEERING    Credit Hours: 3**

**Course Outline**

1. Well Planning
2. Various drilling assemblies for vertical and deviated holes; BHA components, jar placement.
3. Theory of elasticity in drilling operation.
4. Fatigue and failure of drill pipes, hydraulics and casing design, further design analysis of drill bits.
5. Fishing Operations; Basic Fishing Tools; Optimization of drilling parameters and related problems, Well control procedure in conjunction with International Well Control Forum (IWCF).
6. General Inspection of Drilling Rig; Inspection of Safety Critical Rig Equipment and drilling Tubulars; international inspection standards.

**Recommended Books**

1. Applied Drilling Engineering by A. T. Bourgoyne jr., K. K. Millehim, ISBN: 1555630014.
2. Oil Well Drilling Engineering Principles & Practice by Hussain Rabia, ISBN: 0860107140.
3. Petroleum Well Construction by Michael J. Economides, Larry T. Watters ISBN: 0471969389
4. Casing Design; Theory and Practice by S. S. Rahman, G. V. Chillingarian ISBN: 0444540628
5. Fundamentals of Casing Design by Hussain Rabia, ISBN: 0860108635
6. Formulas and Calculation for Drilling, Production and Workover by Norton J. Lapeyrouse, ASIN: B001MT21K0
7. Drill String Design Handbook by Willain C. Koger ASIN: B0006S40IE.
8. Horizontal Well Technology by S. D. Joshi, ISBN: 0878143505.
9. Well Cementing by Erik B. Nelson, ISBN: 0444555803

10. Advanced Well Control by David Watson, Terry Brittenham, ISBN: 1555631010.

**PET-505 ADVANCED RESERVOIR ENGINEERING Credit Hours: 3**

**Course Outline**

1. **Background:** Introduction to reservoir engineering. Reservoir life cycle. Drive mechanisms. Reserve estimation and global reserve portfolio. Reservoir pressures. Abnormal pressure, fluid pressures in hydrocarbon systems, pressure gradients around the water oil contact, techniques for pressure measurement (MDT/RFT/static/dynamic surveys). Reservoir development strategies and appraisal methods.
2. **Water Influx and Aquifer Support:** Aquifer characterization / classification. Recognition of natural water influx. Water influx, water drive characteristics, models for water encroachment, hydraulic analogs of water influx, unsteady – state (Van Everdingen-Hurst), Fetkovitch method for water influx volume determination. Identification of water level rise in reservoir.
3. **Reservoir Performance:** Generalized and linear forms of material balance equation. Application of material balance equation for OOIP/OGIP/Gas cap size determination. Depletion performance and decline rate. Offsetting decline and extending plateau. Production forecast against pressure decline and time. Performance prediction with Instantaneous GOR, Tracy, Muskat and Turner methods.
4. **Displacement Processes:** Immiscible displacement processes. Relative permeability and mobility ratio and its impact on displacement. Buckley-Leverett unidirectional displacement. Recovery efficiency (areal and vertical), water flooding. Water flooding patterns, fractional flow of fluids.

**Recommended Books**

1. Fundamentals of Reservoir Engineering, by L. P. Dake, ISBN: 044441830X.
2. Applied Petroleum Reservoir Engineering by B. C. Craft and M. F. Hawkin, ISBN: 0130398845.
3. Applied Reservoir Engineering Vol. I & II, by Charles Robert Smith, G.W. Tracy, ISBN: 0930972155.
4. Oil Reservoir Engineering, by Sylvain Joseph Pirson, ISBN: 0882755005.
5. Fundamental of Reservoir Engineering by Ben H. Caudle, ASIN: B0007GPIIQ.
6. Reservoir Engineering Manual, by Frank W. Cole, ASIN: B003AA4LKW.



7. A Generalized Approach to Primary Hydrocarbon Recovery of Petroleum Exploration & Production, by M. Walsh and L. W. Lake, ISBN: 0444506837.
8. Natural Gas Production Engineering by Chi U. Iko, ISBN: 0894646397.
9. Gas Production Operations by Dale Beggs, ASIN: B001O78FVY.
10. Gas Reservoir Engineering by W. John Lee, ISBN: 1555630731.

**PET-506      APPLIED RESERVOIR SIMULATION      Credit Hours: 3**

**Course Outline**

1. A review of basic mathematics and reservoir engineering concepts in reservoir simulation.
2. Formulation of reservoir simulation equations.
3. Setting up the finite difference model.
4. Solution of the finite difference model (explicit or implicit in pressure/saturation).
5. Solving the matrix of simultaneous equations. Examples.
6. Uses and misuses of reservoir simulation.
7. Selection of a proper reservoir simulator.
8. Application of finite element technique to reservoir simulation.

**Recommended Books**

1. Basic Applied Reservoir Simulation by T. Ertekin, ISBN: 1555630898.
2. Fundamentals of Numerical Reservoir Simulation by Donald W. Peaceman, ISBN: 0444552987.
3. Reservoir Simulation by Calvin, C. Mattax, ISBN: 1555630286.
4. Modern Reservoir Engineering: A Simulation Approach by Henry B. Crichlow, ISBN: 0135974682.
5. Principles of Applied Reservoir Simulation by John R. Fanchi, ISBN: 0750679336.
6. Principles of Hydrocarbon Reservoir Simulation by Gordon W. Thomas, ISBN: 0137111770.

**PET-507      ADVANCED WELL LOG INTERPRETATION      Credit Hours: 3**

**Course Outline**

1. Open hole logging: review of petrophysical parameters, rapid initial interpretation, log interpretation in complex lithology computer processed interpretation,

2. Cased hole logging: review of porosity tool principles, thermal decay time log, cement bond logging, production logs, Cross plotting techniques.
3. Interpretation guideline for sand stone carbonate, Volumetric determination of hydrocarbons from the well logging, Resistivity measurement devices, Electrical spontaneous potential, Static SP, and other resistivity logs (normal, lateral, sonic, acoustic, gamma ray, density log and neutron log),
4. Quantitative analysis,
  - a. Quantitative analysis-I, Density logs, neutron logs, combine porosity logs and resistivity logs,
  - b. Quantitative analysis-II, Shaly sand interpretation, computer processing of well logs, abnormal pressure detection with well logs, fracture detection with well logs.

#### **Recommended Books**

1. Theory, Measurement and Interpretation of Well Logs by Zaki Bissouni.
2. Applied Open hole Well Analysis, Brock.
3. Well Logging I & II, J.R. Jorden & F.L. Campbell.
4. Fundamental of Well Log Interpretations (The Intr. of Logging data), O. Serra.

### **PET-508 UNCONVENTIONAL RESERVOIRS Credit Hours: 3**

#### **Course Outline**

1. Unconventional gas resources (tight gas sands, coal bed methane, shale gas and natural gas hydrates and heavy oil); overview, occurrences, hydrocarbon origins, resources estimation, exploration methods, drilling, completion, and stimulation methods, appraisal and well testing, facilities design and production forecasting, time-rate-pressure analysis, integrated reservoir description, reservoir management strategies, limitations on development, present activities, transportation and marketing, economics, environmental and regulatory issues

#### **Recommended Books**

1. Rezaee, R., "Fundamentals of Gas Shale Reservoirs", John Wiley & Sons, 2015.
2. Ma & Holditch, "Unconventional Oil and Gas Resources Handbook: Evaluation and Development", 1<sup>st</sup> Edition, Elsevier, 2015

## **II. Elective Courses (Group-B).**

### **PET-511 DRILLING FLUID HYDRAULICS / ENGINEERING Credit Hours: 3**

#### **Course Outline**

1. Introduction, Development of drilling fluid technology
2. Drilling fluid materials and equipment
3. WBM and OBM Drilling fluid properties
4. Drilling fluid additives
5. Evaluation of drilling fluid performance
6. Hydraulics calculations
7. Concept of Slip Velocity, effective wellbore cleaning
8. Clay mineralogy and Colloid Chemistry of Drilling Fluids, inhibition & Hole stability
9. Drilling Problems related to drilling fluids and their solutions
10. Solid-Control Equipment; High and Low Speed Centrifuges, Desilter, Desander etc.

#### **Recommended Books**

1. Composition and properties of oil well Drilling Fluids. 4<sup>th</sup> Edition By George R. Gray, H. C. H. Darley; Gulf Publishing Company.
2. Drilling fluids Technology By Max R. Annis, Martin v. Smith
3. Composition and properties of oil well Drilling Fluids. By Walter F. Rogers; Gulf Publishing Company.

### **PET-512 HORIZONTAL WELL TECHNOLOGY Credit Hours: 3**

#### **Course Outline**

1. Overview of horizontal well technology, drilling and completion techniques.
2. Horizontal wells in fractured reservoirs, BHA selection, Torque and Drag analysis, Anti-collision concept, Azimuth and Inclination concept.
3. Deflection and steering tools: Overview of open-hole and cased hole side track techniques.
4. Overview to Ultra Short Radius and Extended Reached Wells.
5. Reservoir engineering concepts – skin factor, P.I., flow regimes.
6. Steady – State solution of flow equations.
7. Comparison of Horizontal Wells and fractured vertical wells.
8. Horizontal wells in fractured reservoirs, Pseudo steady – state solution and unsteady – state solutions, Transient well testing.
9. Water and gas conning, Pressure drop through horizontal wells.

**Recommended Books**

1. Horizontal Well Technology by S.D. Joshi. Pennwell Books, Pennwell Publishing Company, Oklahoma, USA
2. Applied Drilling Engineering by A. T. Bourgoyne jr., K. K. Millehim, ISBN: 1555630014.
3. Petroleum Production Systems by Michael J. Economides, A. Daniel Hill, ISBN: 013658683X.

**PET-513 UNDERBALANCED AND MANAGED PRESSURE DRILLING  
Credit Hours: 3****Course Outline**

1. Underbalanced drilling; Techniques and limitations, historical prospective and benefits of UBD.
2. Nitrified drilling, Air drilling, mud-cap drilling concepts, and snub drilling. Selecting an appropriate candidate and technique: geophysical and geological aspects.
3. Surface equipment layout for closed loop managed pressure drilling.
4. Wellbore construction constraints, and fluid selection, economics, wellhead, casing, and completion design, bit selection, drill string design.
5. Blowout Preventer Equipment: primary control, rotating heads, diverters, and surface separators.
6. UBD Well control procedures, managed pressure drilling techniques, dual gradient drilling, micro-flux control drilling, well control, drilling problems, safety and environmental issues.

**Recommended Books**

1. Guo, Boyun and Ghalambor, Ali, "Gas Volume Requirements for Underbalanced Drilling", PennWell Corporation, 2002
2. "A project Management Approach to Underbalanced Operations", Signa Engineering Corp., 1998/ latest edition

**PET-514 OFFSHORE DRILLING Credit Hours: 3****Course Outline**

1. Offshore platforms and mobile vessels
2. Offshore drilling from fixed and floating drilling structures
3. Offshore rigs and equipment's, wellheads, casing program, offshore blowout prevention equipment, the drilling riser, riser tensioning, drilling hydraulics, motion compensation, formation testing, shallow water flow, dual gradient drilling, subsea mud-lift drilling.
4. Horizontal drilling in offshore environment; torque and drag, hydrates and potential problems in deep-water drilling.

### **Recommended Books**

1. Speight, James G., "Handbook of offshore oil and gas operations", Elsevier, 2014.
2. Bommer, Paul Michael, "A Primer of Oilwell Drilling", University of Texas at Austin, 2008.
3. Fang, Huacan, and Menglan Duan, "Offshore Operation Facilities: Equipment and Procedures", Gulf Professional Publishing, 2014.

### **PET-515 WELL CONTROL**

**Credit Hours: 3**

#### **Course Outline**

Basic concepts, gas behaviour, fluid hydrostatic, pore pressure prediction, formation fracture gradients, kick detection and control methods, secondary well control complications, special well control applications, well control equipment's, offshore and subsea well control, blowout control, snubbing and stripping, casing seat selection, SMD well control and well workover/well completion well control.

### **Recommended Books**

1. Watson, D., Brittenham, T., & Moore, P. L., "Advanced well control", Vol. 10, Society of Petroleum Engineers, 2003.
2. Jerome J. Schubert, "Well Control", Texas A&M University, 1995/latest edition

### **PET-516 RESERVOIR ENGINEERING MANAGEMENT**

**Credit Hours: 3**

#### **Course Outline**

1. **Introduction to Reservoir Management:** Primary production, reservoir life cycle offsetting decline, business planning, meeting the short and long term goals.
2. **Reservoir Management Process:** Maintaining well count to meet the production commitments. Offsetting decline. Business development planning and implementation. Production strategies evaluation. Learning from failures and management mistakes.
3. **Reservoir Surveillance:** Common data types. Pressure data collection, validation and isobaric mapping. PVT samples collection for PVT analysis. Using acquired data. Monthly well testing for production allocation and field production potential estimates.
4. **Reservoir Performance Analysis and Forecast:** Natural production mechanisms. Reserve estimates (Volumetric, simulation, decline curve analysis and material balance)

5. **Reservoir Management Economics:** Economic criteria, scenarios, economic evaluation, risk and uncertainties. Economic optimization example.
6. **Case Studies:** Reservoir Management planning for newly discovered fields, secondary and EOR operated fields.

#### **Recommended Books**

1. Fundamentals of Reservoir Engineering by LP Dake, ISBN 044441830X
2. Applied Petroleum Reservoir Engineering by BC Craft and MF Hawkin ISBN 0130398845
3. Applied Reservoir Engineering Vol. I & II by Charles Robert Smith, GW Tracy, ISBN 0930972155
4. Oil Reservoir Engineering by Sylvai Joseph Pirson, ISBN 0882755005
5. Fundamentals of Reservoir Engineering by Ben H Caudle ASIN B0007GPIIQ
6. Reservoir Engineering Manual by Frank W Cole ASIN B003AA4LKW
7. A Generalized Approach to Primary Hydrocarbon Recovery of Petroleum Exploration & Production by M Walsh & LW Lake ISBN 0444506837
8. Natural Gas Production Engineering by Chi U Ikoku ISBN 0894646397

### **PET-517 PETROLEUM RESOURCES AND RESERVE ESTIMATION Credit Hours: 3**

#### **Course Outline**

1. Introduction and importance of reserves/resources to an oil corporation and its shareholders,
2. overview of reserves and resources,
3. classification/definition of proved developed reserves,
4. proved undeveloped reserves, probable reserves, contingent resources, reserves classification/migration examples,
5. SPE PRMS vs. SEC guidelines,
6. reserves estimation methods, deterministic vs. probabilistic methods,
7. financial impact of reserves: depreciation, non-cash costs, and earnings, general understanding of accountability, controls and processes,
8. reserves estimation of unconventional resources

#### **Recommended Books**

1. Cronquist, Chapman: "Estimation and Classification of Reserves of Crude Oil, Natural Gas and Condensate", Society of Petroleum Engineers, 2001.

2. "Guidelines for the Evaluation of Petroleum Reserves & Resources", Society of Petroleum Engineers, 2001

**PET-518 NATURALLY FRACTURED RESERVOIRS**  
**Credit Hours: 3**

**Course Outline**

Specific features of carbonate fractured reservoirs, geological condition of fracturing, fracture evaluation, characterization of fractures, fracture parameters, simplified correlations, quantitative fracture evaluation, physical properties of fractures & matrix, relative permeability curves, capillary pressure curves, drainage and imbibitions displacement process, schematization of drive mechanism by capillary and gravity forces, fracture evaluation through well tests, coning in fracture reservoirs, dual continuum approach. Fractured reservoir performance analysis during imbibition and drainage.

**Recommended Books**

**PET-519 GAS FLOW IN POROUS MEDIA** **Credit Hours: 3**

**Course Outline**

1. Physical properties of porous media with emphasis on transport phenomena in porous media, geometrical and mechanical properties, single-phase flow and (miscible and immiscible) multiphase fluid flow through porous media, and heat transfer in porous media.
2. Reserve calculations for volumetric, water drive, and geo-pressured gas reservoirs.
3. Decline curve analysis, Gas wells deliverability tests.
4. Static and flowing bottomhole pressure.

**Recommended Books**

1. Fundamentals of Reservoir Engineering, by L. P. Dake, ISBN: 044441830X.
2. Applied Petroleum Reservoir Engineering, by B. C. Craft and M. F. Hawkin, ISBN: 0130398845
3. Applied Reservoir Engineering Vol. I & II, by Charles Robert Smith, G.W. Tracy, ISBN: 0930972155.
4. Oil Reservoir Engineering, by Sylvain Joseph Pirson, ISBN: 0882755005.
5. Fundamental of Reservoir Engineering by Ben H. Caudle, ASIN: B0007GPIIQ

6. Reservoir Engineering Manual, by Frank W. Cole, ASIN: B003AA4LKW.
7. A Generalized Approach to Primary Hydrocarbon Recovery of Petroleum Exploration & Production, by M. Walsh and L. W. Lake, ISBN: 0444506837.
8. Natural Gas Production Engineering by Chi U. Ikoku, ISBN: 0894646397.
9. Gas Production Operations by Dale Beggs, ASIN: B001O78FVY.
10. Gas Reservoir Engineering by W. John Lee, ISBN: 1555630731

**PET-520            CARBONATE RESERVOIR CHARACTERIZATION**  
**Credit Hours: 3**

**Course Outline**

The geology and diagenesis of carbonates, sequence stratigraphy, carbonate reservoirs petrophysical properties, rock-fabric classification, depositional textures and petrophysics, reservoir models for input into flow simulators, limestone reservoirs and effects on petrophysical properties distribution, wireline logs for carbonate reservoirs, procedures for core-log calibration and examples of different carbonate reservoirs and effective reservoir management strategies

**Recommended Books**

1. Ahr, WM, "Geology of carbonate reservoirs: the identification, description and characterization of hydrocarbon reservoirs in carbonate rocks", John Wiley & Sons, 2011.
2. Lucia, F. J., "Carbonate reservoir characterization: an integrated approach", Springer Science & Business Media, 2007.
3. Mazzullo, S. J., Rieke, H. H., & Chilingarian, G. V., "Carbonate Reservoir Characterization: A Geologic-Engineering Analysis", Vol. 44, Elsevier, 1996/latest edition

**PET-521    ADVANCED RESERVOIR SIMULATION    Credit Hours: 3**

**Course Outline**

1. The principle objective of this course is to develop a reservoir simulation model, which incorporates the multiphase flow through porous media with 3D aspects.
2. Selecting the rock and fluid properties data required for model construction.
3. Criteria for selecting grid block size.
4. 5- and 9-point geometry, local grid refining (LGR).
5. Establishing initial pressure and saturation distribution (model initialization).
6. Selection of time steps.
7. Limiting the numerical dispersion/ tuning/ data refinement.



8. Sensitivity analysis of fluid distribution and its effect on flow performance and recovery.
9. Production constraints. History and production modes. Well inflow rates and pressure modeling. Well pseudo functions. Coning functions. Running model under injection well rates and pressures. Field Operating conditions.
10. Strategy and plans for history matching. Manual adjustment of history matching parameters. Matching gas and water movement. Adjustment to match pressures, water and gas arrival, GOR and WOR behavior. Automatic history matching. When to use automatic history matching.
11. Planning the production cases to be run. Evaluation predicted well capacities, GOR and WOR and other input history. Review and Analysis of predicted performance like production rate plateau, rate decline, pressure, water cut, ultimate recovery and other output based on objectives of the case study.
12. Compositional simulation, miscible displacement, chemical and polymer flooding.

#### **Recommended Books**

1. SPE Monograph Series Reservoir Simulation, Calvin, C. Mattax and Robert L. Dalton
2. Reservoir Simulation by Khalid Aziz & Tony Settari
3. Ertekin, T., Abou-Kassem, J. H., & King, G. R., "Basic applied reservoir simulation", Society of Petroleum Engineers, 2001.
4. Applied Reservoir Simulation by Ertekin
5. Applied Numerical method, Donald L. Katz.
6. Fundamental of Numerical Reservoir Simulation, D.W. Peaceman
7. Modern Reservoir Simulation by Hennery B. Crichlow.
8. Principle of Applied Reservoir Simulation, John R. Fanchi
9. Principles Hydrocarbon Reservoir Simulation by G.W. Thomas

**PET-522**

**WELL STIMULATION DESIGN**

**Credit Hours: 3**

#### **Course Outline**

Stimulation candidate selection, matrix versus fracture acidizing, formation damage issues, acid types and their reaction with various rocks, carbonate rock acidization, acid flow in carbonate rocks, wormhole propagation, optimum injection rate, modelling of matrix acidizing, sandstone formations, mineralogy of clays and feldspars, mud acids and their reactions with silica and silicates, impact of mineralogy on acid selection, field cases of sandstone formations, models to predict acid propagation in sandstones, impact of acidizing on rock strength, acid fracturing, fluid selection, fracture conductivity, field examples, rock mechanics, proppant

characteristics, fluid selection, methods to control proppant flow back and hydraulic fracturing in horizontal wells for unconventional formations.

#### **Recommended Books**

1. Reservoir Stimulation 2<sup>nd</sup> Edition by MJ Economides and Kenneth G. Nolte. ISBN: 0-13-774472-2
2. Oil Well Stimulation by Robert S Schechter. ISBN: 0-13-949934-2.
3. Production Operations by Thomas O Allen and Alan P Roberts ASIN B0070AP640
4. Principles of Oil Well Production by TE W Nind ISBN 007046572
5. Natural Gas Production Engineering by Chi U. Iko, ISBN 0894646397
6. Introduction to Petroleum Production Volume I & II by Dr Skinner ISBN 0872017672
7. Well Performance by Michael Golan and Curtis Whitson, ISBN 9027722838
8. Surface Operation in Petroleum Production by GV Chillingarian J O Robertson ISBN 0444424733
9. Gidley, J. L., "Recent advances in hydraulic fracturing", 1989/latest edition.

**PET-523                      PRODUCTION OPTIMIZATION                      Credit Hours: 3**

#### **Course Outline**

1. **Overview of production optimization**; need, benefits, process steps, petroleum production system, system analysis approach.
2. **Reservoir performance**; reservoir fluid phase behavior, porous media fluid dynamic, pressure drop in reservoir, inflow performance relationship (IPR) models.
3. **Well performance**; overview of well flow models- vertical and deviated, pressure drop in production string, and pressure traverse calculation.
4. **Choke, restriction and flowlines performance**; pressure drop across choke, different valves and flowlines.
5. **System analysis**; NODAL analysis for optimized design of perforation, production string / tubing and other components of the system, sensitivity analysis for flowrate and pressure drop in different components of the production system.
6. Optimizing artificial lift methods / installations.

#### **Recommended Books**

1. Lake, L. W., "Petroleum Engineering Handbook: General Engineering", J. R. Fanchi. Society of Petroleum Engineers, 2006.
2. Beggs, H.D., "Production optimization using nodal analysis", 1991/latest edition

**PET-524      PETROLEUM PRODUCTION OPERATIONS**  
**Credit Hours: 3**

**Course Outline**

Introduction; Reservoir Considerations in Well Completions; Fluid and Rock Properties, Formation Pressure Regimes, Reservoir Fluid Flow, Use of Well Test Analysis in Determining Reservoir Fluid and Rock Properties. Reservoir Drive Mechanisms.

Field Operations; Wire line Operations, Production Logging, Coiled Tubing – scale clean outs, Problem Wells e.g. Formation Damage – Minimization and Stimulation. Primary Cementing, Well Completion Design, Tubing Strings, Packers, Subsurface Control Equipment, Perforating Oil and Gas Wells, Completion and Work over Fluids, Work over Systems; Through-Tubing Production Logging, Work over and Completion Rigs; Squeeze Cementing - Remedial Cementing, Sand Control, Formation Damage, Surfactants for Well Treatments, Acidizing; Hydraulic Fracturing, Scale Deposition, Removal, and Prevention, Corrosion Control.

**Recommended Books**

1. Guo, Boyun, "Petroleum production engineering, a computer-assisted approach", Gulf Professional Publishing, 2011.
2. Stewart, M., "Surface Production Operations: Volume III: Facility Piping and Pipeline Systems", Gulf Professional Publishing, 2015

**PET-525      PETROLEUM PROCESS ENGINEERING      Credit Hours: 3**

**Course Outline**

1. **Gas processing:** Physical Properties of Light Hydrocarbons and Related Compounds, Phase Behavior of Natural Gas Systems, Fluid phase equilibria, Water-hydrocarbon Systems, Flow of Fluids, Mass Transfer, Heat Transfer, Compression & Refrigeration, Dehydration, Desulfurization and dehydration, Flash and differential vaporization, Dew Point Calculation, Critical properties calculations, Fractionation, NGL Recovery Processes, Sulfur Recovery, Cryogenics, Environmental Considerations in Natural Gas Processing.
2. **Oil Processing:** API classification of liquid hydrocarbons, separator design, desalting unit, de-emulsification, design considerations of stock tanks, hazard area classification.

**Recommended Books**

1. Gas Conditioning and Processing by Campbell.
2. Petroleum & Gas Field Processing by H.K. Abdel-Aal.

**PET-526**

**ARTIFICIAL LIFT METHODS**

**Credit Hours: 3**

**Course Outline**

1. **Electrical Submersible Pumps (ESP):** Basic well data collection for ESP design. Sizing the pump for required (design) rate. Pump automation accessories. Pump problems and premature failures. Pump performance optimization. Viscosity correction for various fluids in design. Well design considerations such as deviated and horizontal wells. Sand production and its impact on pump equipment and performance.
2. **Hydraulic Jet Pumps:** Basic well data collection for jet pumps design. Sizing the pump for required (design) rate. Pump automation accessories. Pump problems and premature failures. Pump performance optimization. Viscosity correction for various fluids in design. Well design considerations such as deviated and horizontal wells. Solids production and their design consideration for power fluid.
3. **Gas Lift:** Designing gas lift installation. Selecting and valve types of gas lift for designed rate. Estimating optimum gas injection volumes. Selecting valve setting depths. Power / compressor requirements. Gas lift operation, analysis and troubleshooting.
4. **Progressive Cavity Pumps (PCP):** Pumping heavy oil through PCP.
5. **Sucker Rod Pumps:** Basic well data collection for pump design. Sizing the pump for required (design) rate. Pump automation accessories. Pump problems and premature failures. Pump performance optimization. Viscosity correction for various fluids in design. Well design considerations such as deviated and horizontal wells. Sand production and its impact on pump equipment and performance. Rod loads.
6. **Plunger lift:** Gas well unloading. Tubing and casing mounted plunger lifts. Trouble shooting.
7. **Selecting Optimum Artificial Lift System:** Factors affecting selection like production characteristics, fluid properties, hole and reservoir characteristics, long range recovery, surface facilities, location and power sources available. Operating problems like sand production, paraffin, scale, corrosion, emulsion, bottom hole temperature and surface climate. Relative economics.

**Recommended Books**

1. The Technology of Artificial Lift Methods, Volume II & III by Kermit E Brown. ISBN: 0-87814-031-x

**PET-527**

**PETROLEUM ECONOMICS**

**Credit Hours: 3**

**Course Outline**

1. Principles or economics, estimation of costs, evaluation of costs

2. Evaluation of oil and gas reservoir, oil operations, optimization,
3. Cost, risk and uncertainty analysis, study, application, evaluation and screening of various scenarios
4. Profitability analysis and pay out time
5. Probabilistic approach, Reservoir economics, and Well economics
6. Linear programming theory of forecasts, pipelines, tankers, decision tree methods.
7. Introduction to financial reporting for oil companies, capital budgeting.
8. OPEC cartel, review of annual forecasts from various multinational companies.
9. Oil prices policy.
10. Gas pricing policy.
11. Petroleum concession agreement for Pakistan, its uses and limitations.
12. National Petroleum ordinances and policies / explosives rules.

#### **Recommended Books**

1. Abdel-Aal, H. K., & Alsahlawi, M. A., "Petroleum economics and engineering", CRC Press, 2013
2. Mian, Mohammed A., "Project economics and decision analysis: deterministic models", Vol. 1, Pennwell Books, 2011

#### **PET-528            ADVANCED PETROPHYSICS AND WELL LOGGING Credit Hours: 3**

#### **Course Outline**

Radiometric methods in open and cased boreholes, spectrometry-natural and induced, neutron lifetime logging, mud logging, measurement and logging while drilling, nuclear magnetic resonance (NMR) and dielectric logs, dipmeter and image well logs, picket plots,  $R_w$  (water resistivity) and salinity determination, wellbore seismic applications, properties of clay and shale, shaly sand interpretation, water saturation models in shaly formations, uses of core data, pressure measurements, acoustic and mechanical rock properties, compressional and shear wave logging, cased hole saturation determination, production logging and development of computer models for well log analysis.

#### **Recommended Books**

1. Ellis, D. V., & Singer, J. M., "Well logging for earth scientists", Springer Science & Business Media, 2007.
2. Rider, M., "The Geological Interpretation of Well Logs", 2nd Edition, Whittles Publishing, 2000.

**PET-529      APPLIED BOREHOLE GEOMECHANICS**  
**Credit Hours: 3**

**Course Outline**

1. Fundamentals of rock mechanics
2. Theories of elasticity and failure mechanics
3. Borehole stresses and acoustic wave propagation
4. Laboratory and field methods of acquiring rock mechanics data relevant to field applications
5. Borehole stability, diagnostics, critical mud weight limits to prevent break-outs and mud losses
6. Effects of temperature and mud composition on borehole stability
7. Stability of deviated and horizontal holes
8. Trajectory optimization for deviated wells.
9. Effects of plasticity and modelling of borehole stability.

**Recommended Books**

1. Aadnoy, B., & Looyeh, R., "Petroleum rock mechanics: drilling operations and well design", Gulf Professional Publishing, 2011.
2. Fjar, E., Holt, R. M., Raaen, A. M., Risnes, R., & Horsrud, P., "Petroleum related rock mechanics", Vol. 53, Elsevier, 2008
3. Mark D. Zoback, "Reservoir Geomechanics" 1st Edition.

**PET-530      ADVANCED PETROLEUM GEOLOGY      Credit Hours: 3**

**Course Outline**

1. Conditions controlling primary production and accumulation of organic matter
2. Source rock formation and analysis
3. Conversion of organic material to petroleum
4. Primary and secondary migration of petroleum
5. Porosity and permeability in reservoir rocks
6. Role of depositional environment as a controlling factor for reservoir quality, sequence stratigraphy
7. Classification and formation of petroleum traps
8. Basin types and their petroleum potential and regional petroleum geology of selected petroleum provinces.

**Reference Books**

1. Selley, R. C., & Sonnenberg, S. A., "Elements of petroleum geology", Academic Press, 2014.
2. Bjorlykke, K., "Petroleum geoscience: From sedimentary environments to rock physics", Springer Science & Business Media, 2015

**PET-531 SEISMIC DATA ACQUISITION, PROCESSING AND INTERPRETATION**

**Credit Hours: 3**

**Course Outline**

1. Seismic data acquisition, seismic sources (land and marine)
2. Sensors and recording equipment
3. Environmental aspects related to seismic acquisition, borehole seismic, seabed seismic
4. Seismic processing, three-dimensional seismic exploration, seismic imaging techniques and analysis of seismic data
5. Interpretation of two-dimensional and three-dimensional seismic data on a graphic workstation
6. Production of seismic time contour maps
7. Depth conversion of seismic time maps (both from stack sections and time migrated sections)
8. Inversion of seismic data after stack, use of seismic stratigraphy as interpretation methodology and seismic attribute analysis and AVO

**Recommended Books**

1. Avseth, P., Mukerji, T., & Mavko, G., "Quantitative seismic interpretation: Applying rock physics tools to reduce interpretation risk", Cambridge university press, 2005.
2. Ba, J., Carcione, J. M., Du, O., Zhao, H., & Muller, T., "Seismic Exploration of Hydrocarbons in Heterogeneous Reservoirs: New Theories, Methods and Applications", Elsevier, 2014.

**PET-532 APPLIED MATHEMATICS IN PETROLEUM ENGINEERING**

**Credit Hours: 3**

**Course Outline**

1. Linear Algebra, system of Linear equations, linear dependency, linear transformation, eigen values and Eigen vectors, Diagonalization.
2. Vector Calculus.
3. Partial differential equations and PDE's solution methods.
4. Initial value problem in general PDE with variable coefficient.
5. Solution of Linear Hyperbolic Equations. Solutions of Diffusivity Equation
6. Laplace Transforms, Green's Function, Bessel Functions and Boundary Value methods

**Recommended Books**

1. Karris, S. T., "Numerical Analysis using MATLAB and EXCEL", Orchard Publications, 2007
2. LeVeque, R. J., "Finite difference methods for ordinary and partial differential equations: steady-state and time-dependent problems", Vol. 98, Siam, 2007.

**PET-533 HEALTH, SAFETY AND ENVIRONMENT Credit Hours: 3****Course Outline**

1. Introduction to safety, health and environmental management
2. Importance of safety, safety assurance and assessment
3. Safety measures in design and process operations
4. Risk assessment, management and analysis of case studies from petroleum industry
5. Environmental design economics
6. Hazard classification and assessment
7. Hazard evaluation and hazard control - HAZOP
8. Environmental issues, impact and management, applied environmental laws, atmospheric pollution, flaring and fugitive release, water pollution, drilling waste, produced water, oil spills, rock cutting, oil sludge, drilling solid waste, production waste, environmental monitoring
9. Accidents modelling, fire and explosion modelling, accident investigation and reporting.

**Recommended Books**

1. Chandrasekaran, Srinivasan, "Health, Safety, and Environmental Management in Offshore and Petroleum Engineering", John Wiley & Sons, 2016.
2. Hughes, Phil, and Ed Ferrett, "Introduction to Health and Safety at Work: For the NEBOSH National General Certificate in Occupational Health and Safety", Routledge, 2015

**PET-534 THERMODYNAMICS AND PHASE BEHAVIOUR OF HYDROCARBON SYSTEMS  
Credit Hours: 3****Course Outline**

1. Fundamental Thermodynamics relationships among fluid properties and thermodynamic properties of real fluids.
2. Thermodynamic equilibrium and stability of pure fluids.
3. Minimization of Gibbs free energy Thermodynamics of mixtures.
4. Principles and application of Equation of State.
5. Vapour-Liquid equilibrium models and phase equilibria calculations.



6. Phase rule.
7. Critical conditions.
8. Sampling techniques for oil and gas-condensate wells, conventional and special PVT studies, cubic equations of state models, characterizing heptane-plus fractions, gas-liquid equilibrium calculations with cubic equation of state models, tuning equation of state models
9. Comparison between black oil and compositional models for volatile and gas condensate reservoirs and determination of reservoir fluid composition from recombination tests.

#### **Recommended Books**

1. Ahmed, T. H., "Hydrocarbon phase behaviour", Vol. 7, Gulf Pub Co, latest edition.
2. Danesh, A., "PVT and phase behaviour of petroleum reservoir fluids", Vol. 47, Elsevier, 1998/ latest edition
3. Whitson, C. H., & Brulé, M. R. "Phase behaviour", Henry L. Doherty Memorial Fund of AIME, Society of Petroleum Engineers, 2000.\ latest edition

### **III. RESEARCH THESIS**

1. **PET-600 THESIS/DESSERTATION** **Credit Hours: 0+6**

## **ANNEX-A**

### **Content List**

#### **Course-I: Sociology and Development**

1. Introduction to Sociology
  - a. What is sociology?
  - b. Nature, Scope, and Importance of Sociology
  - c. Social Interactions
  - d. Social Groups
  - e. Social Institutions
2. Culture and Related Concepts
  - a. Definition of Culture
  - b. Types of Culture
  - c. Elements of Culture
  - d. Role of Culture in Organization
  - e. Socialization and Personality
3. Interpersonal Relations
  - a. Interpersonal Behaviour
  - b. Formation of Personal Attitudes
  - c. Language and Communication
  - d. Motivations and Emotions
  - e. Public Opinion
4. Social Stratification
  - a. Factors of Social Stratification
  - b. Caste and class
  - c. Power, Prestige, and Authority
  - d. Social Mobility
  - e. Migration
5. Human Ecology
  - a. Ecological Processes
  - b. Ecosystem and energy
  - c. Ecosystem and Physical Environment
  - d. Solid Waste Disposal
  - e. Pollution
6. Population Dynamics
  - a. World Population Growth and Distribution
  - b. Population Dynamics in Pakistan
  - c. Causes and Consequences of Urbanization
  - d. Population Policy in Pakistan
  - e. Population and Development
7. Community Development
  - a. Meaning, Scope, and Subject Matter of Community Development
  - b. Processes of Community Development
  - c. Community Development Programs in Pakistan

- d. Community Organization and Related Services
- e. Cooperation and Conflict in Community Development
- 8. Deviance and Crime
  - a. Crime as a Social and Cultural Phenomenon
  - b. Crime and Social Organization
  - c. Organized Crime
  - d. Culture Based Crime
  - e. Economics of Crime
- 9. Sociology of Change and Development
  - a. What is Social Change and Development?
  - b. Dynamics of Social Change
  - c. Role of NGOs in Development
  - d. World System and Development
  - e. Gender and Development

Course-II: Social Anthropology

- 1. Introduction
  - a. Anthropology and Social Anthropology
  - b. Fields of Anthropology
  - c. Anthropological Research Methods
  - d. Social Anthropology and other Social Sciences
  - e. Significance of Social Anthropology
- 2. Culture
  - a. Definition, Properties and Taxonomy
  - b. Evolution of Growth and Culture
  - c. Evolution of Man: Religious and Modern Perspectives
  - d. Evolution of Culture
  - e. Culture and Personality
- 3. Evolution and Growth of Culture
  - a. Evolution of Man
  - b. Schools of Thought in Cultural Anthropology
  - c. Acculturation
  - d. Enculturation
  - e. Ethnocentrism and Xenocentrism
- 4. Language and Culture
  - a. Communication
  - b. Structural Linguistics
  - c. Historical Linguistics
  - d. Relationship between Language and Culture
  - e. Ethnography
- 5. Economic System
  - a. Global Economic System
  - b. The Allocation of Resources
  - c. The Conversion of Resources
  - d. The Distribution of Goods and Services
  - e. Poverty and Inequality

6. Marriage and Family
  - a. Marriage and Mate Selection
  - b. The Family: Types and Functions
  - c. Kinship System
  - d. Structure and Function of Family
  - e. Gender Relations
7. Political Organization
  - a. Political Sociology
  - b. Origin of Political Organization and Organizational System
  - c. Types of Political Organizations
  - d. Power Politics and Factionalism in Pakistan
  - e. Resolution of Conflict
8. Religion and Magic
  - a. The Universality of Religion
  - b. Comparative Religions
  - c. Religion and Society
  - d. Religious Beliefs and Practices
  - e. Witchcraft and Sorcery
9. Culture Change
  - a. Forms of Art
  - b. Expressive Culture
  - c. Process of Cultural Change
  - d. Cultural Change in the Modern World
  - e. Cultural Change in Pakistani society

Course: III: Understanding Psychology and Human Behaviour

1. What is Psychology?
2. Nature, Scope and Application with Special Reference to Pakistan
3. Different Schools of Psychology
4. Methods of Psychology
5. Learning
6. Intelligence and Artificial Intelligence
7. Personality and its Assessment
8. Understanding Maladjustive Behaviour
9. Positive Emotional States and Processes
10. Stress Management and Anger Management

Course-IV: Professional Psychology

1. Introduction to Professional Psychology
2. Psychological Testing
3. Educational Psychology
4. Industrial/Organizational Psychology
5. Social Psychology
6. Health Psychology
7. Clinical Psychology
8. Positive Psychology

9. Legal, Ethical, and Professional Issues.

Course-V: Professional Ethics

1. An Overview of Business Ethics
  - a. Business Ethics Defined, Social Responsibility, and Business Ethics
  - b. The Development of Business Ethics, Why study Business Ethics?
  - c. Framework for Studying Business Ethics.
2. Ethical issues in Business
  - a. Foundation of Ethical Conflict,
  - b. Classifications of Ethical Issues
  - c. Ethical Issues Related to Participants and Functional Areas of Business, Recognizing an Ethical Issue.
3. Applying Moral Philosophies to Business Ethics
  - a. Moral Philosophy Defined,
  - b. Moral Philosophy Perspectives.
4. Social Responsibility
  - a. The Economic Dimension,
  - b. The legal Dimension,
  - c. The Ethical Dimension,
  - d. the Philanthropic Dimension.
5. An Ethical Decision-Making Framework
  - a. Ethical Issue Intensity,
  - b. Individual Factors: Stages of Cognitive Moral Development, Corporate Culture, Significant others, Opportunity, Business Ethics Evaluations and Intentions, Using the Ethical Decision-Making Framework to Improve Ethical Decisions.
6. How the Organization Influences Ethical Decision Making:
  - a. Organizational Structure and Business Ethics,
  - b. the role of Corporate Culture in Ethical Decision- Making,
  - c. Group Dimensions of Organizational Structure and Culture,
  - d. Implications of Organizational Relationships for Ethical Decisions.
7. The Role of Opportunity and Conflict:
  - a. Opportunity
  - b. Conflict.
8. Development of an Effective Ethics Programme
  - a. An Effective Ethical Compliance,
  - b. Programme,
  - c. Codes of Ethics and Compliance Standards,
  - d. High-Level Manager's Responsibility for Ethical Compliance Programme and the Delegation of Authority
  - e. Effective Communication of Ethical Standards
  - f. Establishing Systems to Monitor, Audit, and Enforce Ethical Standards

- g. Continuous Improvement of the Ethical Compliance Programme
  - h. The Influence of Personal Values in Business Ethics Programmes
  - i. The Ethical Compliance Audit.
9. International Business Ethics
- a. Ethical Perceptions and International Business
  - b. Culture as a Factor in Business
  - c. Adapting Ethical Systems to a Global Framework: Cultural Relativism, the Multinational Corporation, A universal Set of Ethics, Ethical Issues Around the Globe.

Course-VI: Organizational Behaviour

- 1. Introduction to Organizational Behaviour
  - a. Organizational Disciplines and topics
  - b. Psychological Perspective
  - c. Social-Psychological Perspectives
- 2. Structure and Control in Organization
  - a. Introduction
  - b. Bureaucracy
  - c. Managerial Work
  - d. Contingency theory
  - e. Organizational Design
- 3. Individual and Work Learning
  - a. Learning Theories
  - b. Learning and Work
- 4. Stress
  - a. Types of Stress and Work
  - b. Occupational Stress Management
- 5. Individual Differences
  - a. Personality and its factors
  - b. Personality dimensions and social learning
  - c. Intelligence
- 6. Motivation and Job Satisfaction
  - a. Needs at Work
  - b. Theories of Motivation and job satisfaction
  - c. Correlates of Job satisfaction
- 7. Group and Work
  - a. Social Interaction
  - b. Dramaturgy and impression Management
  - c. Social Skill
- 8. Group and Inter group Behaviour
  - a. Group Structure and Norms
  - b. Group Processes
  - c. How throne Studies
- 9. Leadership
  - a. Leadership as an attribute

- b. Leadership Style
- 10. Patterns of Work
  - a. Work-the classical approach
  - b. Marx, Weber, and The critique of labor
  - c. Foucault and Disciplinary Power
- 11. Conflict and Consent in Work
  - a. The labor Process debate
  - b. Work place control and resistance
  - c. Industrial conflict and industrial relations
- 12. Organizational culture
  - a. Organizational culture and strategic management
  - b. Exploring organizational culture
  - c. Evaluating concept of culture

Course-VII: Introduction to Sociology

- 1. The Nature of Sociology
  - a. The study of social life
  - b. Exploring the global village
  - c. Sociology as a science
  - d. The Sociological imagination
  - e. The development of Sociology
  - f. Pioneers of Sociology
  - g. Nature, scope and subject matter of Sociology
  - h. Brief historical development of Sociology
  - i. Society and community
  - j. Relationship with other social sciences
  - k. Social Interaction Processes
- 2. Social groups
  - a. Definition and functions
  - b. Types of social groups
- 3. Social institutions
  - a. Definition
  - b. Structure and function of social institutions
  - c. Inter-relationships among various social institutions
- 4. Culture and related concepts
  - a. Definition and aspects of culture
  - b. Elements of culture
  - c. Organization of culture
  - d. Other concepts, cultural relativism, sub cultures, ethnocentrism, culture lag
- 5. Socialization and personality
  - a. Role and status
  - b. Socialization
  - c. Culture and personality
- 6. Deviance and social control
  - a. Definition and types of deviance
  - b. Juvenile delinquency

- c. Formal and information methods of social control
- 7. Social stratification
  - a. Approach to study social stratification
  - b. Caste class and race as basics of social stratification
- 8. Major perspectives in Sociology
  - a. Functionalist perspective
  - b. Conflict perspective
  - c. Interactionstic perspective
- 9. Social Control and deviance
  - a. Agencies of social control
- 10. Social stratification
  - a. Determinants of social stratification
  - b. Social mobility, types and definition
  - c. Dynamics of social mobility
- 11. Concept of social movement
  - a. Theories of social movement
  - b. Social and cultural change
- 12. Social and cultural change
  - a. Definition of social change Dynamics of social change
  - b. Impact of globalization on society and culture
  - c. Resistance to change
- 13. Collective behavior
  - a. Definition
  - b. Characteristics
  - c. Causes
  - d. Types
  - e. Social movements
  - f. Mob and crowd behaviour

Course-VIII: Critical Thinking

- 1. The Power of Critical Thinking
  - a. Claims and Reasons
  - b. Reasons and Arguments
  - c. Arguments in the Rough
- 2. The Environment of Critical Thinking
  - a. Perils of Haunted Mind
  - b. Self and the Power of the Group
  - c. Subjective and Social Relativism
  - d. Skepticism
- 3. Making Sense of Arguments
  - a. Arguments Basics
  - b. Patterns
  - c. Diagramming Arguments
  - d. Assessing Long Arguments
- 4. Reasons for Belief and Doubt
  - a. Conflict Experts and Evidence
  - b. Personal Experience



- c. Fooling Ourselves
- d. Claims in the News
- 5. Faulty Reasoning
  - a. Irrelevant Premises
  - b. Genetic Fallacy, Composition, Division
  - c. Appeal to the Person, Equivocation, Appeal to Popularity
  - d. Appeal to Tradition, Appeal to Ignorance, Appeal to Emotion
  - e. Red Herring, Straw Man
- 6. Unacceptable Premises
  - a. Begging the Question, False Dilemma
  - b. Slippery Slope, Hasty Generalization
  - c. Faulty Analogy
- 7. Deductive Reasoning: Propositional Logic
  - a. Connectives and Truth Values
  - b. Conjunction, Disjunction, Negation
  - c. Conditional, Checking for Validity
  - d. Simple Arguments, Tricky Arguments
  - e. Streamlined Evaluation
- 8. Deductive Reasoning: Categorical Logic
  - a. Statements and Classes
  - b. Translations and Standard Form
  - c. Terms, Quantifiers
  - d. Diagramming Categorical Statements
  - e. Sizing up Categorical Syllogisms
- 9. Inductive Reasons
  - a. Enumerative Induction
  - b. Sample Size, Representativeness, Opinion Polls
  - c. Analogical Induction
  - d. Casual Arguments, Testing for Causes
  - e. Casual Confusions
- 10. Inference to the Best Explanation
  - a. Explanations and Inference
  - b. Theories and Consistency
  - c. Theories and Criteria
  - d. Testability, Fruitfulness, Scope, Simplicity
  - e. Conservatism
- 11. Judging Scientific Theories
  - a. Science and Not Science
  - b. The Scientific method, Testing Scientific Theories
  - c. Judging Scientific Theories
  - d. Copernicus versus Ptolemy, Evolution Versus Creationism
  - e. Science and Weird Theories
  - f. Making Weird Mistakes
  - g. Leaping to the Weirdest Theory, Mixing What Seems with What is
  - h. Misunderstanding the Possibilities

- i. Judging Weird Theories
  - j. Crop Circles, Talking with the Dead
- Course-IX: Introduction to Philosophy
1. Definition and Nature of Philosophy
  2. Theory of Knowledge
    - a. Opinion and Knowledge
    - b. Plato, the Republic Selection
    - c. Knowledge through Reason
    - d. Descartes Meditation on First Philosophy
    - e. Knowledge through Experience
    - f. Hume an Inquiry concerning Human Understanding (Selection)
    - g. Experience Structured by the Mind
    - h. Kant Critique of Pure Reason (Selection)
    - i. Knowing and Doing
    - j. James Pragmatism (Selection)
    - k. Knowledge and Emotion
    - l. Jagger Love and Knowledge (Selection)
    - m. Philosophy of Religion
    - n. Proving that Existence of God
    - o. Anselm, Aquinas, Paley, Dawkins (Selection)
    - p. Justifying Religious Beliefs
    - q. Pascal Pensees (Selection)
    - r. James The will to Believe Selection
    - s. Freud the Future of An Illusion (Selection)
    - t. Confronting the Problems of Evil
    - u. Mackie Evil and Omnipotence (Complete)
    - v. Hick Philosophy of Religion (Selection)
  3. Metaphysics
    - a. Idealism and Materialism
    - b. Berkeley Three Dialogues Between Hylas and Pholonous (Selection)
    - c. Armstrong Naturalism, Materialism and First Philosophy (Selection)
    - d. The Mid-Body Problem
    - e. Descartes Meditations on First Philosophy (Selection)
    - f. O'Hear Introduction to the Philosophy of Science (Selection)
    - g. Dennett The Origins of Selves (Complete)
    - h. Pali Canon (Selection)
    - i. Penelhum Religion and Rationality (Selection)
  4. Freedom to Choose
    - a. Libertarianism
    - b. James The Dilemma of Determinism (Selection)
    - c. Taylor Metaphysics (Selection)
    - d. Determinism
    - e. Hospers Meaning and Free Will (Selection)

- f. Skinner Walden Two (Selection)
  - g. Compatibilism
  - h. State Religion and the Modern Mind (Selection)
  - i. Radhakrishnan Indian Philosophy (Selection)
5. Ethics
- a. Fulfilling Human Nature
  - b. Aristotle Nicomachean Ethics (selection)
  - c. Loving God
  - d. Augustine The Morals of the Catholic Church and the City of God (Selection)
  - e. Following Natural Law
  - f. Aquinas Summa Theologiae (Selection)
  - g. Doing One's Duty
  - h. Kant Fundamental Principles of the Metaphysics of Morals (Selection)
  - i. Maximizing Utility
  - j. Mill Utilitarianism (Selection)
  - k. Turning Values of Upside Down
  - l. Nietzsche Human, All too Human and Beyond Good and Evil (Selection)
  - m. Creating Ourselves
  - n. Sartre Existentialism is a Humanism (Selection)
  - o. Hearing the Feminine Voice
  - p. Gilligan In a Different Voice (Selection)
  - q. Baier What Do Women Want in a Moral Theory (Selection)
6. Political and Social Philosophy
- a. The State as Natural
  - b. Plato the Republic (Selection)
  - c. Aristotle Politics (Selection)
  - d. The State as a Social Contract
  - e. Hobbes Philosophical Rudiments Concerning Government and Society (Selection)
  - f. Locke the Second Treatise of Government (Selection)
  - g. Liberty of the Individual
  - h. Mill On Liberty (Selection)
  - i. Alienation in Capitalism
  - j. Marx Economic and Philosophic Manuscripts of 1844 (Selection)
  - k. Justice and Social Trust
  - l. Rawls A Theory of Justice (Selection)
  - m. Nozick Anarchy, State, and Utopia (Selection)
  - n. Held Rights and Goods (Selection)
  - o. Women in Society
  - p. Wollstonecraft A Vindication of the Rights of Women (Selection)
  - q. De Behaviour The Second Sex (Selection)

- r. The Value of Philosophy
- s. Russel The Problems of Philosophy (Selection)
- t. Midgley Philosophical Plumbing (Selection)

Course-X: Entrepreneurship

1. Introduction
  - a. The concept of entrepreneurship,
  - b. The economist view of entrepreneurship,
  - c. The sociologist view,
  - d. Behavioural approach,
  - e. Entrepreneurship and Management
2. The Practice of Entrepreneurship
  - a. The process of entrepreneurship, Entrepreneurial Management, The entrepreneurial business, Entrepreneurship in service institutions, The new venture
3. Entrepreneurship and Innovation
  - a. The innovation concepts,
  - b. Importance of innovation for entrepreneurship,
  - c. Sources of innovative opportunities,
  - d. The innovation process,
  - e. Risks involved in innovation
4. Developing Entrepreneur
  - a. Entrepreneurial profile, Trait approach to understanding entrepreneurship, Factors influencing entrepreneurship, The environment, Socio cultural factors, Support systems
5. Entrepreneurship Organization
  - a. Team work, Networking organization,
  - b. Motivation and compensation,
  - c. Value system
6. Entrepreneurship and SMES
  - a. Defining SMEs, Scope of SMEs, Entrepreneurial managers of SME, Financial and marketing problems of SMEs
7. Entrepreneurial Marketing
  - a. Framework for developing entrepreneurial marketing,
  - b. Devising entrepreneurial marketing plan,
  - c. Entrepreneurial marketing strategies,
  - d. Product quality and design
8. Entrepreneurship and Economic Development
  - a. Role of entrepreneur in the economic development generation of services,
  - b. Employment creation and training, Ideas, knowledge and skill development,
  - c. The Japanese experience
9. Case Studies of Successful Entrepreneurs

Course-XI: Principles of Management

1. Introduction, overview and scope of discipline
2. The evolution and emergence of management thought

3. Management functions
4. Planning concepts, objectives, strategies and policies
5. Decision making
6. Organizing; departmentalization, line/staff authority, commitments and group decision making
7. Staffing: principles of selection, performance, career planning
8. Leading: Motivation, leadership, communication
9. Controlling: the system and process and techniques of controlling
10. Management and Society: future perspective

### **Practicum**

NIL

### **Bibliography/References**

1. Books:
  - Course-I
    - a. Allport, G. W. (1985). *The Historical Background of Modern Social Psychology*. New York, Random House.
    - b. Bernard, A. and T. Burgess (2004). *Sociology*, Cambridge University Press.
    - c. DuBrin, A. J. (2007). *Human Relations: Interpersonal Job Oriented Skills*. New York, Prentice Hall.
    - d. Gardezi, H. N., Ed. (1991). *Understanding Pakistan: The Colonial Factor in Societal Development*. Lahore, Maktaba Fikr-o-Danish.
    - e. Hafeez, S. (1991). *Changing Pakistan Society*. Karachi, Royal Book Company. Gardezi, H. N., Ed. (1991).
    - f. Jones, G. W. (2005). "Why are Population and Development Issues not given Priority?" *Asia-Pacific Population Journal* **20**(1).
    - g. Macionis, J. J. (1999). *Sociology 7UPUth UPU Edition*, National Book Foundation, Islamabad
    - h. Maser, C. (1997). *Sustainable Community Development: Principles and Concepts*. Florida St. Lucie Press.
    - i. Nelson, N. and S. Wright (1995). *Power and Participatory Development: Theory and Practice*. London, Intermediate Technology Publications.
    - j. Syed, S. H. (2003). *The State of Migration and Multiculturalism in Pakistan: The Need for Policy and Strategy*. Islamabad, UNESCO: 1-30.
    - k. Utton, A. E. (1976). *Human Ecology*, West View Press.
    - l. Webster, A. (1990). *Introduction to Sociology of Development*. London, Nacmillan Education Ltd.
    - m. Weiss, A. M. (2001). *Power and civil society in Pakistan*, Oxford University press.

#### Course-II

- a. Ahmad, Akbar S. 1990. Pakistani Society, Karachi, Royal Books Co.
- b. Bernard, H. Russel. 1994. Research Methods in Anthropology, Qualitative and Quantitative Approaches. London: Sage Publications
- c. Bodley, John H. 1994. Cultural Anthropology, California: Mayfield Publishing Co.
- d. Brogger, Jan. 1993. Social Anthropology and the Lonely Crowd. New Delhi: Reliance Publishing
- e. Ember, Carol R. and Ember Melvin. 2005. Anthropology, 11<sup>th</sup> Ed. Englewood Cliffs: Prentice Hall, Ince. Harper and Row
- f. Harris Marvin. 1987. Cultural Anthropology. New York: Harper and Row
- g. Harris Marvin. 1985. Culture, People, nature; An Introduction to General Anthropology London: Harper and Row
- h. Haviland, W. A. (2005). UAnthropology: The Human ChallengeU. New York, Thomson Learning Inc.
- i. Hertzler J. O. 1981. The Social Structure of Islam. Cambridge: Cambridge University Press.
- j. Keesing, Roger m. 1998. Cultural Anthropology: A contemporary perspective. 3<sup>rd</sup> ed. New York: Harcourt Brace College Publishers.
- k. Kottak, Conard Phillip. 2002. Anthropology: The Exploration of Human Diversity. 9<sup>th</sup> Ed. Boston: McGraw Hill Higher Education.
- l. Kennedy, Charles H. 1992. Pakistan London: Westview Press,.
- m. Marron, Stanley. 1057. Pakistani Society and Culture. New Heaven
- n. Wilson, Richard A. 1996. Human Rights, Culture and Context: Anthropological Perspective. London: Pluto Press.

#### Course-III

- a. Atkinson R.C., and Smith E.E. (2000), Introduction to Psychology (13PthP ed.), Harcourt Brace College Publishers.
- b. Fernald, L.D., and Fernald, P.S. (2005), Introduction to Psychology, USA: WMC Brown Publishers.
- c. Hergenhahn, B.R. (2001). An Introduction to the History of Psychology, New York: Wadsworth.
- d. Goodwin, C.J, (2000) Research in Psychology: Methods and Design, (3<sup>rd</sup> Ed.), New York: John Wiley and Sons.
- e. Synder, C.R., and Lopez, S.J. (2007) Positive Psychology, USA, Sage Publications.
- f. Allen, B.P. (1997), Personality Theories: Development, Growth and Diversity, (2<sup>nd</sup> Ed.), Boston: Allyn and Bacon.

- g. Cohen, R.J., and Swerdlik, M.E. (2005) Psychological Testing and Assessment (6<sup>th</sup> Ed.), New York: McGraw-Hill.
- h. Corcini, R., (2000). Current Psychotherapies. London: Thompson and Co Publishers.
- i. Comer, R.J. (2004). Abnormal Psychology, USA: Freeman and Company.
- j. Schwartz, B., Wasserman, E., and Robbins, S. (2002), Psychology of Learning and Behaviour, 5<sup>th</sup> Ed. Norton and Company.

#### Course-IV

- a. Crow, L., and Crow, A. (2000) Educational Psychology, New Delhi: Euroasia Publishing House Ltd.
- b. Spiegel, P.K., and Koocher, G.P. (1998), Ethics in Psychology, New York: Oxford University Press
- c. Snyder, C.R., and Lopes, S.J. (2000), Handbook of Positive Psychology, New York: Oxford University Press.
- d. Compton, W.C. (2005), Introduction to Positive Psychology, USA, Thomson Wadsworth.
- e. Debra, L.N. and James Compbell Quick, (2000) Organizational Behaviour (3<sup>rd</sup> Ed), Cincinnati: South Western.
- f. Fred Luthans, Alexander, D.S. and Edwin, A. Locke (2000) (Eds), Handbook of Principles of Organizational Behaviour, London: Blackwell.
- g. Brannon, L. and Reist, J. (2000), Health Psychology: An Introduction to Behaviour and Health (4<sup>th</sup> Ed.), USA Wadsworth.
- h. Donohue, W. and Ferguson, K. (Eds), (2003), Handbook of Professional Ethics for Psychologists; Issues, Questions and Controversies, London: Sage Publications.
- i. Meyers, D. (2005), Social Psychology, 8th Ed. McGraw Hill Inc.
- j. Cooper, J. and Hogg, M. (2003) Handbook of Social Psychology, Sage Publications
- k. Halgin, R.P., Whitbourne, S.K., and Halgin, R. (2004), Abnormal Psychology: Clinical Perspectives on Psychological Disorders, New York: McGraw Hill.
- l. Thorndike R.L., and Hage, E.P. (1995), Measurement and Evaluation in Psychology and Education (4<sup>th</sup> Ed.), New York, MacMillan.

#### Course-V

- a. Ferrell, O.C., and Fraedrich, John, Ethical Decision Making and Cases, New York: Houghton Mifflin.

#### Course-VI

- a. Fincham, R., and Rhodes, P. (2003), Principles of Organizational Behaviour, 3<sup>rd</sup> Oxford.
- b. Noe, R., Hollenbeck, J. Gerhart, B., and Wright, P. (2006), Human Resource Management, 5<sup>th</sup> ed., McGraw Hill.
- c. Newstrom John W. (2007), Organizational Behaviour, (12<sup>th</sup> Ed), McGraw Hill.
- d. Luthan Fred, (2005), Organizational Behaviour, McGraw Hill Inc.
- e. Robins, Stephen, (2005), Organizational Behaviour, McGraw Hill Inc.

#### Couse-VII

- a. Neulreck, Kenneth, J. 2005, Sociology: Diversity, Conflict and Change, Boston
- b. Barnard, Andy. 2004. Sociology, Cambridge University Press
- c. Giddens, Anthony, 2004, Sociology 4<sup>th</sup> edition, Cambridge Polity Press
- d. Albrow, Martin, 2003, Sociology, London Routledge.
- e. Richard, T. Schaefer, 2003, Sociology 5<sup>th</sup> edition, McGraw Hill College
- f. Kendall, Diana, 2004. Sociology in our Times, 4<sup>th</sup> ed, Wadsworth
- g. Tyler Melissa, Wallace Claire and Abbott Pamela, 2005, An Introduction to Sociology, 3<sup>rd</sup> ed. Routledge.

#### Course-VIII

- a. Vaughn Lewis, 2005, The Power of Critical Thinking, Oxford University Press.
- b. Paulsen David W., Cederblom Jerry:2000, Critical Reasoning, Wadsworth
- c. Restall Greg. 2005, Logic: An Introduction, Routledge

#### Course-IX

- a. Abel Donald C., Stumpf Samuel Enoch, 2002. Elements of Philosophy: An Introduction, 4<sup>th</sup> Ed. McGraw Hill.
- b. Scruton Roger, 2001. A short History of Modern Philosophy, 2<sup>nd</sup> ed. Routledge.

#### Course-X

- a. Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship
- b. P.N. Singh: Entrepreneurship foOr Economic Growth
- c. Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker
- d. John B. Miner: Entrepreneurial Success



Course-XI

- a. Stephen P. Robins, Mary Coulter: Management
- b. H. Koontz Odonnel and H. Weirich: Management
- c. Mc Farland: Management: Foundation and Practice
- d. Robert M. Fulmer: The New Management

2. Journals/Periodicals:

NIL

3. World Wide Web:

NIL

## RECOMMENDATIONS

### I. General for the Discipline.

- 1) Continuous efforts should be made as well to incorporate current and future national and international requirements.
- 2) Future trends in Petroleum exploration and production as well as its development are being envisioned for incorporation in the curriculum.
- 3) It is recommended that the HEC/PEC should consider to rationalize intake / graduate production of petroleum Engineering at national level, according to absorption and future need of the country as well as of international market.

On the request of the Convener, all the members gave their perspective on the implementation of BE/BS (4-year) and ME/MS program in their respective universities / institutions. The Committee, while composing the draft curriculum, incorporated the suggestions of petroleum industry and other relevant industry where necessary. The following objectives were achieved:

- Final draft of the curriculum in the discipline of Petroleum & Gas Engineering to bring it at par with need-of-the-time.
- Incorporated latest reading & writing material against each course.
- Brought uniformity and developed minimum baseline courses in each and every course of study.
- Efforts were made to bring the curriculum at par with the latest guidelines regarding Outcome based Education (OBE) of Pakistan Engineering Council.

### II. Specific for Undergraduate Program.

1. It was resolved unanimously that the word "Petroleum Engineering" covers and encompassing "Petroleum and Gas Engineering" and it should be resolved
2. The program courses should be taught in line with the national and international needs based upon the changing geo-political and geo-economic dynamics
3. To strengthen the undergraduate program, university support services for lab component may be readily available i.e. lab staff, lab equipment, technical training etc
4. It was emphasized that HEC should facilitate the faculty in the context of orientation of industrial practices for adequate time duration/ Internships for students
5. Field visit for the third and final year students must be facilitated.
6. The pre-requisite(s) are mere guidelines and are flexible to be adjusted by the department / University.

**III. Specific for Post Graduate Program.**

1. To inculcate the skill of research in the graduate student, University may offer “Research methodology” as a credit / non-credit course
2. Further strengthening of research facility in collaboration with industry and HEC.
3. More effective role of industry to further strengthen graduate program.
4. Admission relevant degrees to MS/ME/MEngg are BSc/BE/BS Petroleum Engineering, Geological Engineering, Chemical Engineering, Mechanical Engineering.

## ANNEXURE - A

### English I (Functional English)

**Objectives:** Enhance language skills and develop critical thinking.

#### Course Contents

Basics of Grammar

Parts of speech and use of articles

Sentence structure, active and passive voice

Practice in unified sentence

Analysis of phrase, clause and sentence structure

Transitive and intransitive verbs

Punctuation and spelling

#### Comprehension

Answers to questions on a given text

#### Discussion

General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

#### Listening

To be improved by showing documentaries/films carefully selected by subject teachers

#### Translation skills

##### Urdu to English

##### Paragraph writing

Topics to be chosen at the discretion of the teacher

#### Presentation skills

Introduction

*Note: Extensive reading is required for vocabulary building*

## **Recommended Books**

### **1. Functional English**

#### **a) Grammar**

1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

#### **b) Writing**

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

#### **c) Reading/Comprehension**

1. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

#### **d) Speaking**

## **English II (Communication Skills)**

**Objectives:** Enable the students to meet their real life communication needs.

### **Course Contents:**

#### **Paragraph writing**

Practice in writing a good, unified and coherent paragraph

#### **Essay writing**

Introduction

## **CV and job application**

Translation skills

Urdu to English

## **Study skills**

Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

## **Academic skills**

Letter/memo writing, minutes of meetings, use of library and internet

## **Presentation skills**

Personality development (emphasis on content, style and pronunciation)

*Note: documentaries to be shown for discussion and review*

## **Recommended Books**

### **Communication Skills**

#### a) Grammar

1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

#### b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

#### c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.

2. Reading and Study Skills by John Langan
3. Study Skills by Richard York.

### **English III (Technical Writing and Presentation Skills)**

**Objectives:** Enhance language skills and develop critical thinking

#### **Course Contents**

#### **Presentation skills**

##### **Essay writing**

Descriptive, narrative, discursive, argumentative

##### **Academic writing**

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

##### **Technical Report writing**

##### **Progress report writing**

*Note: Extensive reading is required for vocabulary building*

#### **Recommended Books**

Technical Writing and Presentation Skills

##### a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
2. College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.
3. Patterns of College Writing (4<sup>th</sup> edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

b) Presentation Skills

c) Reading

The Mercury Reader. A Custom Publication. Compiled by Northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharon. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).



**Pakistan Studies (Compulsory)**

**Introduction/Objectives**

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

**Course Outline**

**1. Historical Perspective**

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
  - i. Indus Civilization
  - ii. Muslim advent
  - iii. Location and geo-physical features.

**2. Government and Politics in Pakistan**

Political and constitutional phases:

- a. 1947-58
- b. 1958-71
- c. 1971-77
- d. 1977-88
- e. 1988-99
- f. 1999 onward

**3. Contemporary Pakistan**

- a. Economic institutions and issues
- b. Society and social structure
- c. Ethnicity
- d. Foreign policy of Pakistan and challenges
- e. Futuristic outlook of Pakistan

### Recommended Books

1. Burki, Shahid Javed. *State & Society in Pakistan*, The MacMillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S. M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Bangladesh*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development*. Kent England: Wm Dawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh*. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan*. Boston: Houghton Mifflin, 1967.
12. Aziz, K. K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research, 1993.

## ANNEXURE - C

### ISLAMIC STUDIES (Compulsory)

#### Objectives

This course is aimed at:

- 1 To provide Basic information about Islamic Studies
- 2 To enhance understanding of the students regarding Islamic Civilization
- 3 To improve Students skill to perform prayers and other worships
- 4 To enhance the skill of the students for understanding of issues related to faith and religious life.

#### Detail of Courses

##### Introduction to Quranic Studies

1. Basic Concepts of Quran
2. History of Quran
3. Uloom-ul-Quran

##### Study of Selected Text of Holly Quran

1. Verses of Surah Al-Baqara Related to Faith (Verse No-284-286)
2. Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
3. Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4. Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
5. Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)

##### Study of Selected Text of Holly Quran

1. Verses of Surah Al-Ihزاب Related to Adab al-Nabi (Verse No.6, 21, 40, 56, 57, 58.)
2. Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3. Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

**Seerat of Holy Prophet (S.A.W) I**

1. Life of Muhammad Bin Abdullah ( Before Prophet Hood)
2. Life of Holy Prophet (S.A.W) in Makkah
3. Important Lessons Derived from the life of Holy Prophet in Makkah

**Seerat of Holy Prophet (S.A.W) II**

1. Life of Holy Prophet (S.A.W) in Madina
2. Important Events of Life Holy Prophet in Madina
3. Important Lessons Derived from the life of Holy Prophet in Madina

**Introduction to Sunnah**

1. Basic Concepts of Hadith
2. History of Hadith
3. Kinds of Hadith
4. Uloom –ul-Hadith
5. Sunnah & Hadith
6. Legal Position of Sunnah

**Selected Study from Text of Hadith****Introduction to Islamic Law & Jurisprudence**

1. Basic Concepts of Islamic Law & Jurisprudence
2. History & Importance of Islamic Law & Jurisprudence
3. Sources of Islamic Law & Jurisprudence
4. Nature of Differences in Islamic Law
5. Islam and Sectarianism

**Islamic Culture & Civilization**

1. Basic Concepts of Islamic Culture & Civilization
2. Historical Development of Islamic Culture & Civilization
3. Characteristics of Islamic Culture & Civilization
4. Islamic Culture & Civilization and Contemporary Issues

**Islam & Science**

1. Basic Concepts of Islam & Science
2. Contributions of Muslims in the Development of Science
3. Quran & Science

**Islamic Economic System**

1. Basic Concepts of Islamic Economic System
2. Means of Distribution of wealth in Islamic Economics

3. Islamic Concept of Riba
4. Islamic Ways of Trade & Commerce

### **Political System of Islam**

1. Basic Concepts of Islamic Political System
2. Islamic Concept of Sovereignty
3. Basic Institutions of Govt. in Islam

### **Islamic History**

1. Period of Khlaft-E-Rashida
2. Period of Ummayyads
3. Period of Abbasids

### **Social System of Islam**

1. Basic Concepts of Social System of Islam
2. Elements of Family
3. Ethical Values of Islam

### **Reference Books**

1. Hameed ullah Muhammad, "Emergence of Islam", IRI, Islamabad
2. Hameed ullah Muhammad, "Muslim Conduct of State"
3. Hameed ullah Muhammad, "Introduction to Islam"
4. Mulana Muhammad Yousaf Islahi,"
5. Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
6. Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
7. Mir Waliullah, "Muslim Jurisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
8. H. S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
9. Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

**Note: One course will be selected from the following six courses of Mathematics.**

**COMPULSORY MATHEMATICS  
COURSES FOR BS (4 YEAR)  
(FOR STUDENTS NOT MAJORING IN  
MATHEMATICS)**

**1. MATHEMATICS I (ALGEBRA)**

**Prerequisite(s):** Mathematics at secondary level

**Credit Hours:** 3 + 0

**Specific Objectives of the Course:** To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.

**Course Outline:**

*Preliminaries:* Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions. *Matrices:* Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

*Quadratic Equations:* Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

*Sequences and Series:* Arithmetic progression, geometric progression, harmonic progression. *Binomial Theorem:* Introduction to mathematical induction, binomial theorem with rational and irrational indices. *Trigonometry:* Fundamentals of trigonometry, trigonometric identities.

### Recommended Books

1. Dolciani MP, Wooton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin, Boston (suggested text)
2. Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston
3. Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6<sup>th</sup> edition), 1986, PWS-Kent Company, Boston

## 2. MATHEMATICS II (CALCULUS)

**Prerequisite(s):** Mathematics I (Algebra)

**Credit Hours:** 3 + 0

**Specific Objectives of the Course:** To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

### Course Outline

*Preliminaries:* Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities. *Limits and Continuity:* Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

*Derivatives and their Applications:* Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

*Integration and Definite Integrals:* Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

### Recommended Books

1. Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8<sup>th</sup> edition), 2005, John Wiley, New York
2. Stewart J, *Calculus* (3<sup>rd</sup> edition), 1995, Brooks/Cole (suggested text)
3. Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston
4. Thomas GB, Finney AR, *Calculus* (11<sup>th</sup> edition), 2005, Addison-Wesley, Reading, Ma, USA

### 3. MATHEMATICS III (GEOMETRY)

**Prerequisite(s):** Mathematics II (Calculus)

**Credit Hours:** 3 + 0

**Specific Objectives of the Course:** To prepare the students, not majoring in mathematics, with the essential tools of geometry to apply the concepts and the techniques in their respective disciplines.

#### **Course Outline**

*Geometry in Two Dimensions:* Cartesian-coördinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line.

*Circle:* Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions.

*Conic Sections:* Parabola, ellipse, hyperbola, the general-second-degree equation

#### **Recommended Books**

1. Abraham S, *Analytic Geometry*, Scott, Freshman and Company, 1969
2. Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston
3. Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6<sup>th</sup> edition), 1986, PWS-Kent Company, Boston

### 4. COURSE FOR NON-MATHEMATICS MAJORS IN SOCIAL SCIENCES

<i>Title of subject:</i>		MATHEMATICS
<i>Discipline</i>	:	BS (Social Sciences).
<i>Pre-requisites</i>	:	SSC (Metric) level Mathematics
<i>Credit Hours</i>	:	03 + 00
<i>Minimum Contact Hours:</i>		40
<i>Assessment</i>	:	written examination;
<i>Effective</i>	:	2008 and onward



**Aims** : To give the basic knowledge of Mathematics and prepare the students not majoring in mathematics.

**Objectives** : After completion of this course the student should be able to:

- Understand the use of the essential tools of basic mathematics;
- Apply the concepts and the techniques in their respective disciplines;
- Model the effects non-isothermal problems through different domains;

**Contents** :

**1. Algebra**

*Preliminaries:* Real and complex numbers, Introduction to sets, set operations, functions, types of functions. *Matrices:* Introduction to matrices, types of matrices, inverse of matrices, determinants, system of linear equations, Cramer's rule. *Quadratic equations:* Solution of quadratic equations, nature of roots of quadratic equations, equations reducible to quadratic equations. *Sequence and Series:* Arithmetic, geometric and harmonic progressions. *Permutation and combinations:* Introduction to permutation and combinations, *Binomial Theorem:* Introduction to binomial theorem. *Trigonometry:* Fundamentals of trigonometry, trigonometric identities. *Graphs:* Graph of straight line, circle and trigonometric functions.

**2. Statistics**

*Introduction:* Meaning and definition of statistics, relationship of statistics with social science, characteristics of statistics, limitations of statistics and main division of statistics. *Frequency distribution:* Organisation of data, array, ungrouped and grouped data, types of frequency series, individual, discrete and continuous series, tally sheet method, graphic presentation of the frequency distribution, bar frequency diagram histogram, frequency polygon, cumulative frequency curve. *Measures of central tendency:* Mean, median and modes, quartiles, deciles and percentiles. *Measures of dispersion:* Range, inter quartile deviation, mean deviation, standard deviation, variance, moments, skewness and kurtosis.

### **Recommended Books**

1. Swokowski. E. W., '*Fundamentals of Algebra and Trigonometry*', Latest Edition.
2. Kaufmann. J. E., '*College Algebra and Trigonometry*', PWS-Kent Company, Boston, Latest Edition.
3. Walpole, R. E., '*Introduction of Statistics*', Prentice Hall, Latest Edition.
4. Wilcox, R. R., '*Statistics for The Social Sciences*',

### **5. MATHEMATICS FOR CHEMISTRY**

**Credit Hours:** 3

**Prerequisites:** Mathematics at Secondary level

#### **Specific Objectives of Course:**

To prepare the students not majoring in mathematics with the essential tools of Calculus to apply the concepts and the techniques in their respective disciplines.

#### **Course Outline**

*Preliminaries:* Real Numbers and the Real Line, *Functions and their graphs:* Polynomial Functions, Rational Functions, Trigonometric Functions, and Transcendental Functions. Slope of a Line, Equation of a Line, Solution of equations involving absolute values, Inequalities. *Limits and Continuity:* Limit of a Function, Left Hand and Right Hand Limits, Continuity, Continuous Functions. *Derivatives and its Applications:* Differentiation of Polynomial, Rational and Transcendental Functions, Extreme Values of Functions. *Integration and Indefinite Integrals:* Integration by Substitution, Integration by Parts, Change of Variables in Indefinite Integrals. Least-Squares Line.

### **Recommended Books**

1. Thomas, Calculus, 11<sup>th</sup> Edition. Addison Wesley publishing company, 2005.
2. H. Anton, I. Bevens, S. Davis, Calculus, 8<sup>th</sup> edition, John Willey & Sons, Inc. 2005.
3. Hughes-Hallett, Gleason, McCallum, et al, Calculus Single and Multivariable, 3<sup>rd</sup> Edition. John Wiley & Sons, Inc. 2002.
4. Frank A. Jr, Elliott Mendelsohn, Calculus, Schaum's Outline Series, 4<sup>th</sup> edition, 1999.

5. E. W. Swokowski, Calculus and Analytic Geometry PWS Publishers, Boston, 1983.
6. John H. Mathews, Numerical Methods for Mathematics Science and Engineering, Prentice-Hall, Second Edition 1992.

## 6. MATHEMATICS FOR PHYSICS

### Contents

#### 1. Preliminary calculus.

- Differentiation  
Differentiation from first principles; products; the chain rule; quotients; implicit differentiation; logarithmic differentiation; Leibnitz' theorem; special points of a function; theorems of differentiation.
- Integration  
Integration from first principles; the inverse of differentiation; integration by inspection; sinusoidal function; logarithmic integration; integration using partial fractions; substitution method; integration by parts; reduction formulae; infinite and improper integrals; plane polar coordinates; integral inequalities; applications of integration.

#### 2. Complex numbers and hyperbolic functions

- The need for complex numbers
- Manipulation of complex numbers  
Additions and subtraction; modulus and argument; multiplication; complex conjugate; division
- Polar representation of complex numbers Multiplication and division in polar form
- de Moivre's theorem  
Trigonometrical identities; finding the nth roots of unity; solving polynomial equations
- Complex logarithms and complex powers
- Applications to differentiation and integration
- Hyperbolic functions

Definitions; hyperbolic-trigonometric analogies; identities of hyperbolic functions; solving hyperbolic equations; inverses of hyperbolic functions; calculus of hyperbolic functions

### **3. Series and limits**

- Series
- Summation of series  
Arithmetic series; geometric series; arithmetico-geometric series; the difference method; series involving natural numbers; transformation of series
- Convergence of infinite series  
Absolute and conditional convergence; convergence of a series containing only real positive terms; alternating series test
- Operations with series
- Power series  
Convergence of power series; operations with power series
- Taylor series  
Taylor's theorem; approximation errors in Taylor series; standard McLaurin series
- Evaluation of limits

### **4. Partial differentiation**

- Definition of the partial derivative
- The total differential and total derivative
- Exact and inexact differentials
- Useful theorems of partial differentiation
- The chain rule
- Change of variables
- Taylor's theorem for many-variable functions
- Stationary values of many-variable functions
- Stationary values under constraints

### **5. Multiple integrals**

- Double integrals
- Triple integrals

- Applications of multiple integrals  
Areas and volumes; masses, centers of mass and centroids;  
Pappus' theorems; moments of inertia; mean values of functions
- Change of variables in multiple integrals  
Change of variables in double integrals;

## 6. Vector algebra

- Scalars and vectors
- Addition and subtraction of vectors
- Multiplication by a scalar
- Basis vectors and components
- Magnitude of a vectors
- Multiplication of vectors  
Scalar product; vector product; scalar triple product; vector triple product
- Equations of lines and planes  
Equation of a line; equation of a plane
- Using vectors to find distances  
Point to line; point to plane; line to line; line to plane
- Reciprocal vectors

## 7. Matrices and vector spaces

- Vectors spaces Basic vectors; the inner product; some useful inequalities
- Matrices
- The complex and Hermitian conjugates of a matrix
- The determinant of a matrix  
Properties of determinants
- The inverse of a matrix
- The rank of a matrix
- Simultaneous linear equations  
N simultaneous linear equations in N unknowns
- Special square matrices  
Diagonal; symmetric and antisymmetric; orthogonal; Hermitian;  
unitary normal

- Eigen vectors and eigen values  
Of a normal matrix; of Hermitian and anti-Hermitian matrices; of a unitary matrix; of a general square matrix
- Determination of eigen values and eigen vectors Degenerate eigen values

### **8. Vector calculus**

- Differentiation of vectors Composite vector expressions; differential of a vector
- Integration of vectors
- Space curves
- Vector functions of several arguments
- Surfaces
- Scalar and vector fields
- Vector operators
- Gradient of a scalar field; divergence of a vector field; curl of a vector field
- Vector operator formulae
- Vector operators acting on sums and products; combinations of grad, div and curl
- Cylindrical and spherical polar coordinates
- Cylindrical polar coordinates; spherical polar coordinates.

## ANNEXURE - E

### Statistics-I

Credit 3 (2-1)

Definition and importance of Statistics in Agriculture, Data Different types of data and variables

Classification and Tabulation of data, Frequency distribution, stem-and-Leaf diagram, Graphical representation of data Histogram, frequency polygon, frequency curve.

Measure of Central tendency, Definition and calculation of Arithmetic mean, Geometric mean, Harmonic mean, Median quantiles and Mode in grouped and un-grouped data.

Measure of Dispersion, Definition and Calculation of Range, quartile deviation, Mean deviation, Standard deviation and variance, coefficient of variation.

### Practical

- a. Frequency Distribution
- b. Stem-and-Leaf diagram
- c. Various types of Graphs
- d. Mean, Geometric mean Harmonic Mean,
- e. Median, Quartiles Deviation, mean Deviation.
- f. Standard Deviation, Variance, Coefficient of variation,
- g. Skewness and kinesis

### Recommended Books

1. Introduction to Statistical Theory Part- I by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. A. Concise Course in A. Level Statistic with world examples by J. Crashaw and J. Chambers (1994)
4. Basic Statistics an Inferential Approach 2<sup>nd</sup> Ed. (1986) Fran II. Dietrich-II and Thomas J. Keans

**Statistics-II****Credit 3 (2-1)**

Sampling Probability and non-Probability Sampling, Simple random sampling stratified random sampling Systematic sampling error, Sampling distribution of mean and difference between two means. Interference Theory: Estimation and testing of hypothesis, Type—I and type-II error, Testing of hypothesis about mean and difference between two means using Z-test and t-test, Paired t-test, Test of association of attributes using  $\chi^2$  (chi-square) Testing hypothesis about variance.

**Practical**

- a. Sampling random sampling
- b. Stratified random sampling.
- c. Sampling distribution of mean
- d. Testing of hypotheses regarding population mean
- e. Testing of hypotheses about the difference between population means
- f. Chi-square test
- g. Testing of Correlation Coefficient
- h. Fitting of simple linear regression
- i. One-way ANOVA
- j. Two-way ANOVA

**Recommended Books**

1. Introduction to Statistical Theory Part-II by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. Principles and Procedures of Statistics A Bio-material approach, 2<sup>nd</sup> Edition, 1980 by R. G. D Steal and James H. Tarric
4. Statistical Procedures for Agricultural Research 2<sup>nd</sup> Edition (1980) by K. A. Gomez and A. A. Gomez



## ANNEXURE - F

Introduction to Information and Communication Technologies

**Course Structure:** Lectures: 2 Labs: 1 **Credit Hours:** 3  
**Pre-requisite:** None **Semester:** 1

### Course Description

This is an introductory course on Information and Communication Technologies. Topics include ICT terminologies, hardware and software components, the internet and World Wide Web, and ICT based applications.

After completing this course, a student will be able to:

- Understand different terms associated with ICT
- Identify various components of a computer system
- Identify the various categories of software and their usage
- Define the basic terms associated with communications and networking
- Understand different terms associated with the Internet and World Wide Web.
- Use various web tools including Web Browsers, E-mail clients and search utilities.
- Use text processing, spreadsheets and presentation tools
- Understand the enabling/pervasive features of ICT

### Course Contents

Basic Definitions & Concepts

Hardware: Computer Systems & Components

Storage Devices, Number Systems

Software: Operating Systems, Programming and Application Software

Introduction to Programming, Databases and Information Systems

Networks

Data Communication

The Internet, Browsers and Search Engines

The Internet: Email, Collaborative Computing and Social Networking

The Internet: E-Commerce

IT Security and other issues

Project Week

Review Week

**Text Books/Reference Books**

1. Introduction to Computers by Peter Norton, 6th International Edition, McGraw-Hill
2. Using Information Technology: A Practical Introduction to Computer & Communications by Williams Sawyer, 6<sup>th</sup> Edition, McGraw-Hill
3. Computers, Communications & information: A user's introduction by Sarah E. Hutchinson, Stacey C. Swayer
4. Fundamentals of Information Technology by Alexis Leon, Mathews Leon, Leon Press.