# REVISED SCHEME OF STUDIES
## 3–YEARS’ DIPLOMA OF ASSOCIATE ENGINEER
### PETRO-CHEMICAL TECHNOLOGY (2015)

**FIRST YEAR**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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**SECOND YEAR**

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**THIRD YEAR**

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**Total** 15 24 23
كل وفق 20 كجم

1- القرآن مجيد
2- القرآن مجيد
3- القرآن مجيد
4- القرآن مجيد
5- القرآن مجيد

1- ان تعالوا لاب حتي تنفعوا مما تحبون
2- واعتصموا بهبل الله جميع ولا تفروا
3- ولا يجر منكم شتان قوم على ان لا تعدوا
4- ان الله يأمركم ان تدوا الامانات الى اهلها
5- ان الله يأمر بالعدل والاحسان
6- ان الصلاة تنهي عن الفحشاء والمنكر
7- لقد كان لكم في رسول الله اسوة حسنة
8- ان اكركم عند الله الفاكم
9- وما اتاكم الرسول فخذوه ومنها كم عنده فاتهم
10- واوفر بالهد
11- وعاهروهم بالمعروف
12- يمحق الله البر ويربى الصدقات
13- واصر على ما اصابك
14-وقولواقولا سديدا
15- ان الدين عند الله الاسلام
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میں اسلام

عظیم مقصد

میں اسلام کے نبوی عقائد و عبادات کے پہلا جان کا اور بیان کر لیے

خودمکمل مقصد

افزاروں اسلام کے اخلاقی و انسانی نوری بیان کر لیے

اسلام کے نبوی عقائد کا انسان کی واقعیت و انسانی تکامل کے چوہدی و انسانی تعلقات کے

عبادات کے اخلاقی و انسانی نوری بیان کر لیے

علیہ عبادات کا فارق بیان کر لیے

عبادات (تمام، مروہ، سرچکا) کے فردی احکامات اور انسانی ویژن کے تعلقات بیان کر لیے

اسلامی عقائد و عبادات کے مطالعہ اپنی زندگی دھار کر آئی ایک اہم اسلامی من کر

اسلامی عقائد و عبادات کے مطالعہ اپنی زندگی دھار کر آئی ایک اہم اسلامی من کر
نصاب اخلاءات سنال أول (غير برملي)

خصائص اخلاءات

Gen III

مقدمات

امداء ضمانات باكالوريا

اختلفات ما في نمط وباحة

امداء ضمانات باكالوريا

مقدمات

امداء ضمانات باكالوريا

مقدمات

امداء ضمانات باكالوريا

مقدمات

امداء ضمانات باكالوريا

مقدمات

امداء ضمانات باكالوريا

مقدمات

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مقدمات

امдей ضمانات باكالوريا

مقدمات
نصاب اغلاقت سال اول

تقریری مقامی

عمومی مشترک - آنل اغلاقت کی وجے کے کلیہ تہذیب سے مراد قیتی اپنے مطالعے کے علاوہ

تخصیصی مقامی - مطالب کے تیار کردہ

متعلقہ مطالعے کے مطالب بیان کر کے

عملی زودیہ سے مطالعے کی تمتی کر کے

این تفصیلات و اور عناصر پر متعلقہ مطالعات کی جشیت اشاعت پیدا کر کے کمتر نفی کر کے

دیا شدہ داری کی انتہائی بیان کر کے

دعا داری کی انتہائی بیان کر کے

تعلیم و تعلیمی اقدامات بیان کر کے

ضرری بیان کی ضرورت بیان کر کے

خوشنیفرت کے بارے بیان کر کے

وقتی پیش نظر کے فوائد بیان کر کے

صفتی اور پاتی اعتماد سے حسن کا وسیع گوہ بیان کر کے

خلاصہ کے فوائد بیان کر کے
مطالعہ پاکستان

حصرہ دویں

نظریہ مقصد
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Eng-112

**ENGLISH**

**Total Contact Hours**

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**AIMS.**

At the end of the course, the students will be equipped with cognitive skill to enable them to present facts in a systematic and logical manner to meet the language demands of dynamic field of commerce and industry for functional day-to-day use and will inculcate skills of reading, writing and comprehension.

**Detail of Contents:**

**PAPER-A**

1. **prose/text** 16 hours
   1.1 First eight essays of Intermediate English Book II

2. **close test** 4 hours
   2.1 A passage comprising 50-100 words will be selected from the text. Every 11th word or any word for that matter will be omitted. The number of missing words will range between 5-10. The chosen word may or may not be the one used in the text, but it should be an appropriate word.

**PAPER-B**

3. **Grammar** 26 hours
   3.1 Sentence Structure.
   3.2 Tenses.
   3.3 Parts of speech.
   3.4 Pronouns
   3.5 Change of Narration.
   3.6 One word for several
   3.7 Words often confused

4. **Composition** 12 hours
   4.1 Letters/Messages
   4.2 Job application letter
   4.3 For a character certificate for grant of scholarship
   4.4 Telegrams, Cablegrams and Radiograms, Telexes, Facsimiles
   4.5 Essay writing
   4.6 Technical Education, Science and Our Life, Computers, Environmental Pollution, Duties of a Student.

5. **Translation** 6 hours
   5.1 Translation from Urdu into English.
   For Foreign Students: A paragraph or a dialogue.

**Recommended Textbooks:**
1. Technical English developed by Mr. Zia Sarwar, Mr. Habib-ur Rehman, Evaluated by
Eng-112 ENGLISH

Instructional Objectives:

**PAPER-A**

1. **Demonstrate better reading, comprehension and vocabulary**
   1.1 Manipulate, skimming and scanning of the text.
   1.2 Identify new ideas.
   1.3 Reproduce facts, characters in own words
   1.4 Write summary of stories

2. **Understand facts of the text**
   2.1 Rewrite words to fill in the blanks recalling the text.
   2.2 Use own words to fill in the blanks.

**PAPER-B**

3. **Apply the rules of grammar in writing and speaking**
   3.1 Use rules of grammar to construct meaningful sentences containing a subject and a predicate.
   3.2 State classification of time, i.e present, past and future and use verb tense correctly in different forms to denote relevant time.
   3.3 Identify function words and content words.
   3.4 Use marks of punctuation to make sense clear.
   3.5 Relate what a person says in direct and indirect forms.
   3.6 Compose his writings.
   3.7 Distinguish between confusing words.

4. **Apply the concepts of composition writing to practical situations**
   4.1 Use concept to construct applications for employment, for character certificate, for grant of scholarship.
   4.2 Define and write telegrams, cablegrams and radiograms, telexes, facsimiles
   4.3 Describe steps of a good composition writing.
   4.4 Describe features of a good composition.
   4.5 Describe methods of composition writing
   4.6 Use these concepts to organize facts and describe them systematically in practical situation.

5. **Applies rules of translation**
   5.1 Describe confusion.
   5.2 Describe rules of translation.
   5.3 Use rules of translation from Urdu to English in simple paragraph and sentences.
MATH-113  APPLIED MATHEMATICS-I

Total Contact Hours          T   P   C
Theory                    96  3   0   3

Pre-requisite: Must have completed a course of Elective Mathematics at Metric level.

AIMS.
After completing the course the students will be able to

1. Solve problems of Algebra, Trigonometry, vectors, Mensuration, Matrices and Determinants.
2. Develop skill, mathematical attitudes and logical perception in the use of mathematical instruments as required in the technological fields.
3. Acquire mathematical clarity and insight in the solution of technical problems.

Detail of Contents:

1. Quadratic equations           6 Hours
   1.1 Standard Form
   1.2 Solution
   1.3 Nature of roots
   1.4 Sum & Product of roots
   1.5 Formation
   1.6 Problems

2. Arithmetic progression and series. 3 Hours
   2.1 Sequence
   2.2 Series
   2.3 nth term
   2.4 Sum of the first n terms
   2.5 Means
   2.6 Problems

3. Geometric progression and series. 3 Hours
   3.1 nth term
   3.2 Sum of the first n terms
   3.3 Means
   3.4 Infinite Geometric progression
   3.5 Problems

4. Binomial theorem            6 Hours
   4.1 Factorials
   4.2 Binomial Expression
   4.3 Binomial Co-efficient
   4.4 Statement
   4.5 The General Term
   4.6 The Binomial Series
   4.7 Problems.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Time</th>
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<tbody>
<tr>
<td>5. Partial fractions</td>
<td>6 Hours</td>
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<tr>
<td>5.1 Introduction</td>
<td></td>
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<td>5.2 Linear Distinct Factors Case I</td>
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<td>5.3 Linear Repeated Factors Case II</td>
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<tr>
<td>5.4 Quadratic Distinct Factors Case III</td>
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<td>5.5 Quadratic Repeated Factors Case IV</td>
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<td>5.6 Problems</td>
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<tr>
<td>6. Fundamentals of trigonometry</td>
<td>6 Hours</td>
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<tr>
<td>6.1 Angles</td>
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<td>6.2 Quadrants</td>
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<td>6.3 Measurements of Angles</td>
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<tr>
<td>6.4 Relation between Sexagesimal &amp; circular system</td>
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<tr>
<td>6.5 Relation between Length of a Circular Arc &amp; the Radian Measure of its central Angle</td>
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<td>6.6 Problems</td>
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<tr>
<td>7. Trigonometric functions and ratios</td>
<td>6 Hours</td>
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<tr>
<td>7.1 Trigonometric functions of any angle</td>
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<tr>
<td>7.2 Signs of trigonometric Functions</td>
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<td>7.3 Trigonometric Ratios of particular Angles</td>
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<td>7.4 Fundamental Identities</td>
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<td>7.5 Problems</td>
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<tr>
<td>8. General identities</td>
<td>6 Hours</td>
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<tr>
<td>8.1 The Fundamental Law</td>
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<td>8.2 Deductions</td>
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<td>8.3 Sum &amp; Difference Formulae</td>
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<td>8.4 Double Angle Identities</td>
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<td>8.5 Half Angle Identities</td>
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<td>8.6 Conversion of sum or difference to products</td>
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<td>8.7 Problems</td>
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<td>9. Solution of triangles</td>
<td>6 Hours</td>
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<tr>
<td>9.1 The law of Sines</td>
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<td>9.2 The law of Cosines</td>
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<tr>
<td>9.3 Measurement of Heights &amp; Distances</td>
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<td>9.4 Problems</td>
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<tr>
<td>10. Mensuration of solids</td>
<td>30 Hours</td>
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<tr>
<td>10.1 Review of regular plane figures and Simpson's Rule</td>
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<td>10.2 Prisms</td>
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<td>10.3 Cylinders</td>
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<td>10.4 Pyramids</td>
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<td>10.5 Cones</td>
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<td>10.6 Frusta</td>
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<td>10.7 Spheres</td>
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<tr>
<td>11. Vectors</td>
<td>9 Hours</td>
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<tr>
<td>11.1 Scalers &amp; Vectors</td>
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<tr>
<td>11.2 Addition &amp; Subtraction</td>
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</tbody>
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11.3 The unit Vectors i, j, k
11.4 Direction Cosines
11.5 Scales or Dot Product
11.6 Deductions
11.7 Dot product in terms of orthogonal components
11.8 Vector or cross Product
11.9 Deductions
11.10 Analytic Expression for a x b.
11.11 Problems

12. Matrices and determinants 9 Hours
12.1 Definition of Matrix
12.2 Rows & Columns
12.3 Order of a Matrix
12.4 Algebra of Matrices
12.5 Determinants
12.6 Properties of Determinants
12.7 Solution of Linear Equations
12.8 Problems

Recommended Textbooks:

MATH-113

APPLIED MATHEMATICS-I

Instructional Objectives:

1. **Use different methods for the solution of quadratic equations.**
   1.1 Define a standard quadratic equation.
   1.2 Use methods of factorization and method of completing the square for solving the equations.
   1.3 Derive quadratic formula.
   1.4 Write expression for the discriminate.
   1.5 Explain nature of the roots of a quadratic equation.
   1.6 Calculate sum and product of the roots.
   1.7 Form a quadratic equation from the given roots.
   1.8 Solve problems involving quadratic equations.

2. **Understand apply concept of arithmetic progression and series.**
   2.1 Define an Arithmetic sequence and a series.
   2.2 Derive formula for the nth term of an A.P.
   2.3 Explain Arithmetic Mean between two given numbers.
   2.4 Insert n Arithmetic means between two numbers.
   2.5 Derive formulas for summation of an Arithmetic series.
   2.6 Solve problems on Arithmetic Progression and Series.

3. **Understand geometric progression and series.**
   3.1 Define a geometric sequence and a series.
   3.2 Derive formula for nth term of a G.P.
   3.3 Explain geometric mean between two numbers.
   3.4 Insert n geometric means between two numbers.
   3.5 Derive a formula for the summation of geometric Series.
   3.6 Deduce a formula for the summation of an infinite G.P.
   3.7 Solve problems using these formulas.

4. **Expand and extract roots of a binomial.**
   4.1 State binomial theorem for positive integral index.
   4.2 Explain binomial coefficients: (n,0), (n,1),...,(n,r),...,(n,n)
   4.3 Derive expression for the general term.
   4.4 Calculate the specified terms.
   4.5 Expand a binomial of a given index.
   4.6 Extract the specified roots.
   4.7 Compute the approximate value to a given decimal place.
   4.8 Solve problems involving binomials.

5. **Resolve a single fraction into partial fractions using different methods.**
   5.1 Define a partial fraction, a proper and an improper fraction.
   5.2 Explain all the four types of partial fractions.
   5.3 Set up equivalent partial fractions for each type.
   5.4 Explain the methods for finding constants involved.
5.5 Resolve a single fraction into partial fractions.
5.6 Solve problems involving all the four types.

6. **Understand systems of measurement of angles.**
6.1 Define angles and the related terms.
6.2 Illustrate the generation of an angle.
6.3 Explain sexagesimal and circular systems for the measurement of angles.
6.4 Derive the relationship between radian and degree.
6.5 Convert radians to degrees and vice versa.
6.6 Derive a formula for the circular measure of a central angle.
6.7 Use this formula for solving problems.

7. **Apply basic concepts and principles of trigonometric functions.**
7.1 Define the basic trigonometric functions/ratios of an angle as ratios of the sides of a right triangle.
7.2 Derive fundamental identities.
7.3 Find trigonometric ratios of particular angles.
7.4 Draw the graph of trigonometric functions.
7.5 Solve problems involving trigonometric functions.

8. **Use trigonometric identities in solving technological problems.**
8.1 List fundamental identities.
8.2 Prove the fundamental law.
8.3 Deduce important results.
8.4 Derive sum and difference formulas.
8.5 Establish half angle, double angle & triple angle formulas.
8.6 Convert sum or difference into product & vice versa.
8.7 Solve problems.

9. **Use concepts, properties and laws of trigonometric functions for solving triangles.**
9.1 Define angle of elevation and angle of depression.
9.2 Prove the law of sines and the law of cosines.
9.3 Explain elements of a triangle.
9.4 Solve triangles and the problems involving heights and distances.

10. **Use principles of mensuration in finding surfaces, volumes and weights of solids.**
10.1 Define mensuration of plane and solid figures.
10.2 List formulas for perimeters & areas of plane figure.
10.3 Define pyramid and cone.
10.4 Define frusta of pyramid and cone.
10.5 Define a sphere and a shell.
10.6 Calculate the total surface and volume of each type of solid.
10.7 Compute weight of solids.
10.8 Solve problems of these solids.

11. **Use the concept and principles of vectors in solving technological problems.**
11.1 Define vector quantity.
11.2 Explain addition and subtraction of vector.
11.3 Illustrate unit vectors i, j, k.
11.4 Express a vector in the component form.
11.5 Explain magnitude, unit vector, direction cosines of a vector.
11.6 Derive analytic expression for dot product and cross product of two vectors.
11.7 Deduce conditions of perpendicularity and parallelism of two vectors.
11.8 Solve problems

12. **Use the concept of matrices & determinants in solving technological problems.**
   12.1 Define a matrix and a determinant.
   12.2 List types of matrices.
   12.3 Define transpose, adjoint and inverse of a matrix.
   12.4 State properties of determinants.
   12.5 Explain basic concepts.
   12.6 Explain algebra of matrices.
   12.7 Solve linear equation by matrices.
   12.8 Explain the solution of a determinant.
   12.9 Use Crammers Rule for solving linear equations.
APPLIED PHYSICS

Phy-123

TOTAL CONTACT HOURS:

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AIMS:
The students will be able to understand the fundamental principles and concepts of physics use these to solve problems in practical situations/technological courses and understand concepts to learn advance physics and technical courses.

COURSE CONTENTS

1. Measurements
   1.1 Fundamental units and derived units.
   1.2 Systems of measurement and S.I Units.
   1.3 Concept of dimensions, dimensional formula.
   1.4 Conversion from one system to another.
   1.5 Significant Figures.

2. Scalars and Vectors
   2.1 Revision of head to tail rule.
   2.2 Laws of parallelogram, triangle, and polygon of forces.
   2.3 Resolution of a vector.
   2.4 Addition of vectors by rectangular components.
   2.5 Multiplication of two vectors, dot product and cross product.

3. Motion.
   3.1 Review of laws and equations of motion.
   3.2 Law of conservation of momentum.
   3.3 Angular motion.
   3.4 Relation between linear and angular motion.
   3.5 Centripetal acceleration and force.
   3.6 Educations of angular motion.

4. Torque, Equilibrium, and Rotational Inertia
   4.1 Torque.
   4.2 Center of gravity and center of mass.
   4.3 Equilibrium and its conditions.
   4.4 Torque and angular acceleration.
   4.5 Rotational inertia.

5. Wave Motion.
   5.1 Review Hook’s law of elasticity.
   5.2 Motion under an elastic restoring force.
   5.3 Characteristics of simple harmonic motion.
   5.4 S.H.M and circular motion.
   5.5 Simple pendulum.
   5.6 Wave form of S.H.M.
   5.7 Resonance.
   5.8 Transverse vibration of a stretched string.

6. Sound
   6.1 Longitudinal Waves.
   6.2 Intensity, loudness, pitch, and quality of sound.
   6.3 Units of intensity of level and frequency response of ear.
   6.4 Interference of sound waves, silence zones, beats.
   6.5 Acoustics.
   6.6 Doppler effect.
7. **Light** 5 Hours
   7.1 Review law of reflection and refraction
   7.2 Image formation by mirrors and lenses.
   7.3 Optical instruments.
   7.4 Wave theory of light.
   7.5 Interface, diffraction, polarization of light waves.
   7.6 Applications of polarization in sun glasses, optical activity and stress analysis.

8. **Optical Fiber** 2 Hours
   8.1 Optical communication and problems.
   8.2 Review total internal reflection and critical angle.
   8.3 Structure of optical fiber.
   8.4 Fiber material and manufacture.
   8.5 Optical fiber – Uses.

9. **Lasers** 3 Hours
   9.1 Corpuscular theory of light.
   9.2 Emission and absorption of light.
   9.3 Stimulated absorption and absorption of light.
   9.4 Laser principle.
   9.5 Structure and working of lasers.
   9.6 Types of lasers with brief description.
   9.7 Applications, basic concepts.
   9.8 Material processing.
   9.9 Laser welding.
   9.10 Laser assisted machining.
   9.11 Micro matching.
   9.12 Drilling, scribing and making.
   9.13 Printing.

10. **Heat** 4 Hours
    10.1 Review of calorimetry and gas laws.
    10.2 Thermal expansion of solids, liquid, and gases.
    10.3 Heat of fusion, vaporization.
    10.4 Humidity, absolute and relative.
    10.5 Law of cooling.
    10.6 Thermoelectricity.
    10.7 Thermocouple.

11. **Thermodynamics** 4 Hours
    11.1 Heat energy and internal energy.
    11.2 First law of thermodynamics.
    11.3 Isometric and adiabatic processes.
    11.4 Efficiency of heat engine.
    11.5 Second law of thermodynamics (both statements).
    11.6 Heat engine and refrigerator.

12. **Transfer of Heat** 5 Hours
    12.1 Review modes of transfer of heat.
    12.2 Emission and absorption of heat.
    12.3 Black Body Radiation.
    12.4 Laws of energy distribution.
    12.5 Plank’s Quantum Theory.
    12.6 The photoelectric effect.
    12.7 X-rays, production, properties, and uses.

13. **Electromagnetic Waves** 3 Hours
    13.1 Magnetic field around a current carrying conductor.
    13.2 Electric field induced around a changing magnetic flux.
    13.3 Moving fields.
    13.4 Types of electromagnetic waves.
13.5 Generation of radio waves.
13.6 Spectrum of electromagnetic waves.

14. **Atomic Nucleus**
14.1 Structure of the nucleus.
14.2 Radioactivity.
14.3 Radioactive series.
14.4 Transmutation of elements.
14.5 The fission reaction.
14.6 The fusion reaction.
14.7 The nuclear reactor.

15. **Nuclear Radiations.**
15.1 Properties and interaction with matter.
15.2 Radiation detectors.
15.3 Radiation damage and its effects.
15.4 Radiation therapy
15.5 Radioactive tracers.
15.6 Application of radiation techniques in archeology, agriculture, chemical industry, polymerization, sterilization, food preservation, gauging and control, radioactivity.

16. **Artificial Satellite**
16.1 Review law of gravitation.
16.2 Escape Velocity.
16.3 Orbital Velocity.
16.4 Geosynchronous and geostationary satellites.
16.5 Use of satellites in data communication.

17. **Magnetic Materials**
17.1 Magnetism.
17.2 Domains theory
17.3 Para, Dia, and Ferromagnetism and magnetic materials.
17.4 B.H. Curve and hysteresis loop.

18. **Semiconductor Materials**
18.1 Crystalline structure of solids.
18.2 Conductors, semiconductors, insulators.
18.3 P-type and N-type materials.
18.4 P-N junction.
18.5 P-N junction as a diode.
18.6 Photovoltaic cell (solar cell).

**BOOKS RECOMMENDED**

1. Tahir Hussain, “Fundamentals of Physics” Vol-I and II.
3. Wells and slusher, “Schaum’s Series Physics”
4. Nelcon and oyborn “Advanced level practical Physics”.
5. Mehboobilahi Malik and Inam-ul-Haq “Practial Physics”.
7. M. Aslam Khan and M. Akramsandhu “Experimental Physics Notes”
PRACTICALS
96 Hours

1. Draw graph representing the functions:
   a) \( y = mx \) for \( m = 0, 0.5, 1, 2 \).
   b) \( y = x^2 \)
   c) \( y = \frac{1}{x} \)

2. Find the volume of a given solid cylinder using vernier calipers.

3. Find the area of cross-section of the given wire using micrometer screw gauge.

4. Prove that force is directly proportional to (a) mass, (b) acceleration, using Flectchers’ Trolley.

5. Verify law of parallelogram of forces using Grave-sand apparatus.

6. Verify law of triangle of forces and Lami’s Theorem.

7. Determine the weight of a given body using:
   a) Law of parallelogram of force.
   b) Law of triangle of force.
   c) Lami’s theorem.


9. Locate the position and magnitude of resultant of like parallel forces.

10. Determine the resultant of two unlike parallel forces.

11. Find the weight of a given body using principle of moments.

12. Locate the center of gravity of regular and irregular shaped bodies.

13. Find young’s Modulus of Elasticity of a metallic wire.


15. Study of frequency of stretched string with length.

16. Study of variation of frequency of stretched sting with tension.

17. Study resonance of air column in resonance tube and find velocity of sound.

18. Find the frequency of the given tuning fork using resonance tube.

19. Find velocity of sound in rod by Kundt’s tube.

20. Verify rectilinear propagation of light and study shadow formation.

21. Study effect of rotation of plane mirror on reflection.

22. Compare the refractive indices of given glass slabs.

23. Find focal length of concave mirror by locating center of curvature.

24. Find focal length of concave mirror by object and image method.

25. Find focal length of concave mirror with converging.

26. Find refractive index of glass by apparent depth.

27. Find refractive index of glass by spectrometer.

28. Find focal length of converging lens by plane mirror.

29. Find focal length of converging lens by displacement method.

30. Find focal length of diverging lens using converging lens.

31. Find focal length of diverging lens using concave mirror.

32. Find angular magnification of an astronomical telescope.

33. Find angular magnification of a simple microscope (magnifying glass).

34. Find angular magnification of a compound microscope.

35. Study working and structure of camera.

36. Study working and Structure of Sextant.

37. Compare the different scales of temperature and verify the conversion formula.

38. Determine the specific heat of lead shots.
39. Find the coefficient of linear expansions of a metallic rod.
40. Find the heat of fusion of ice.
41. Find the heat of vaporization.
42. Determine relative humidity using hygrometer.

Phy-123 INSTRUCTIONAL OBJECTIVES

1. Use concepts of Measurement to Practical Situations and Technological Problems.

1.1 Write dimensional formulae for physical quantitates.
1.2 Derive units using dimensional equations.
1.3 Convert a measurement from one system to another.
1.4 Use concepts of measurement and significant figures in problem solving.

2. Use Concepts of scalars and Vectors in Solving Problems involving these Concepts.

2.1 Explain laws of parallelogram, triangle, and polygon of farces.
2.2 Describe method of resolution of vector into components.
2.3 Describe method of addition of vectors by rectangular components.
2.4 Differentiate between dot product of vectors by rectangular components.
2.5 Use the concept in solving problems involving addition, resolution, and multiplication of vectors.

3. Use the law of Conservation of Momentum and Concepts of Angular Motion to Practical situations.

3.1 Use law of conservation of momentum to practical/technological problems.
3.2 Explain relation between linear and angular motion.
3.3 Use concepts and equations of angular motion to solve relevant technological problems.

4. Use Concepts of Torque, Equilibrium, and Rotational Inertia to Practical Situations/Problems.

4.1 Distinguish between center of gravity and center of mass.
4.2 Distinguish between center of gravity and center of mass.
4.3 Explain rotational equilibrium and its conditions.
4.4 Explain rotational inertia giving examples.
4.5 Use the above concepts in solving technological problems.

5. Use concepts of Wave Motion in solving relevant Problems.
5.1 Explain Hook’s law of electricity.
5.2 Derive formula for motion under an elastic restoring force.
5.3 Derive formula for simple harmonic motion and simple pendulum.
5.4 Explain wave from with reference to S.H.M to solve relevant problems.
5.5 Explain resonance.
5.6 Explain transverse vibration of a stretched string.
5.7 Use the above concepts and formulae of S.H.M to solve relevant problems.

6. Understand Concept of Sound.
6.1 Describe longitudinal wave and its propagation.
6.2 Explain the concepts; Intensity, Loudness, Pitch, and Quality of sound.
6.3 Explain Units of intensity of level and frequency response of ear.
6.4 Explain phenomena of silence zone, beats.
6.5 Explain acoustics of buildings.
6.6 Explain Doppler Effect giving mathematical expressions.

7. Use the Concepts of Geometrical Optics to Mirrors and lenses and Understand waves Theory of Light.
7.1 Explain laws of reflection and refraction.
7.2 Use mirror formula to solve problems.
7.3 Use the concepts of image formation by mirrors and lenses to describe working of optical instruments, e.g microscopes, telescopes, camera, and sextant.
7.4 Explain wave theory of light.
7.5 Explain phenomena of interference, diffraction, polarization of light waves.
7.6 Describe uses of polarization given in the course contents.

8.1 Explain the structure of the optical fiber.
8.2 Explain its principal of working.
8.3 Describe uses of optical fiber in industry and medicine.

9. Understand the Structure, working, and Uses of Lasers
9.1 Explain the stimulated emission of radiation.
9.2 Explain the laser principle.
9.3 Describe the structure and working of lasers.
9.4 Distinguish between types of lasers.
9.5 Describe the applications of lasers in the fields mentioned in the course contents.

10.1 Explain calorimetry
10.2 Explain gas laws giving mathematical expressions.
10.3 Explain thermal expression of solids, liquids, and gases.
10.4 Distinguish between heat of fusion, vaporization.
10.5 Distinguish between absolute and relative humidity.
10.6 Describe law of cooling.
10.7 Explain basic concepts of thermoelectricity.
10.8 Describe thermocouple giving its principle, structure, and working.

11. Understand Laws of Thermodynamics
11.1 Distinguish between heat energy and internal energy.
11.2 Explain first law of thermodynamics giving its applications.
11.3 Distinguish between isometric and adiabatic processes.
11.4 Explain second law of thermodynamics describing alternate statements.
11.5 Distinguish between work of heat engine and refrigerator.

12. Understand laws of Energy Distribution and Emission of Radiation
12.1 Explain modes of transfer of heat.
12.2 Explain Black Body Radiation and laws of energy distribution.
12.3 Describe Plank’s Quantum Theory.
12.4 Explain photoelectric effect.
12.5 Explain production, properties, and uses of X-rays.

13. Understand Natural, Types, Generation, and Spectrum of Electromagnetic Waves
13.1 Explain magnetic field due to current, and electric field due to changing magnetic flux.
13.2 Explain moving fields.
13.3 Describe types of electromagnetic waves.
13.4 Explain generation of Radio waves.
13.5 Explain spectrum of electromagnetic waves.

14. Understand the Structure of the Atomic Nucleus and Relevant Activities.
14.1 Describe the structure of the nucleus.
14.2 Explain radioactivity and radioactive series.
14.3 Explain transmutation of elements.
14.4 Distinguish between fission reaction and fusion reaction.
14.5 Explain the structure and working of the nuclear reactor.

15. Understand Nuclear Radiations, Their Effects, and Uses.
15.1 Describe properties of nuclear radiations and their interaction with matter.
15.2 Explain working of radiation detectors.
15.3 Explain damaging effects of nuclear radiations.
15.4 Explain radiation therapy.
15.5 Describe radioactive tracers.
15.6 Describe applications of radiation techniques in course contents.

16. Understand Types and Uses of Artificial Satellites
16.1 Explain escape velocity.
16.2 Explain orbital velocity.
16.3 Distinguish between geosynchronous and geostationary satellites.
16.4 Describe uses of artificial satellites in data communication.

17. Understand Basic Concepts and Classification of Magnetic Materials.
17.1 Explain domains theory of magnetism.
17.2 Distinguish between Para, Dia, and Ferro-magnetism and magnetic materials.
17.3 Distinguish between B and H.
17.4 Describe B.H. Curve.
17.5 Describe hysteresis loop.

18. Understand Basic Concepts of Semi-Conductor Materials and their Uses.
18.1 Explain crystalline structure of solids.
18.2 Distinguish between conductors, semiconductors, insulators.
18.3 Describe semiconductor giving examples with reference to their structure.
18.4 Distinguish between P-type and N-type materials.
18.5 Explain working of P-N junction as a diode.
18.6 Explain working of solar cell.

APPLIED CHEMISTRY

Chem-133

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TOTAL CONTACT HOURS:

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<tbody>
<tr>
<td>Practical</td>
<td>96</td>
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</table>
PRE-REQUISITE:

The student must have studied the subject of Elective Chemistry at Secondary School level.

AIMS:

After studying this course the students:

1. Understands the significance and role of chemistry in the development of modern technology.
2. Becomes acquainted with the basic principal of chemistry.
4. Gains skill for the efficient conduct of practical in a chemistry laboratory.

COURSE CONTENTS

1. Fundamental Concepts of chemistry
   1.1 Chemistry in petroleum and chemical industry.
   1.2 Elements, compounds, and mixtures.
   1.3 Atom, atomic weight, molecule, valency, molecular weight.
   1.4 Symbols, formulae, and equations.
   1.5 Molecular formula, and Empirical formula.
   1.6 Physical and chemical changes.
   1.7 Physical and chemical properties.
   1.8 Acids, bases, and salts.
   1.9 Law of conservation of mass.
   1.10 Law of constant proportions.
   1.11 Law of reciprocal proportions.
   1.12 Law of multiple proportions

2. Structure of Atom and Chemical Bonding
   2.1 Fundamental particles of atom.
   2.2 Bohr’s model of atom and its defects.
   2.3 Energy levels, sub-energy levels and orbitals.
   2.4 Electronic configuration.
   2.5 Ionization potential, electronegativity, and electron affinity.
   2.6 Ionic bond with examples.
   2.7 Covalent bond (polar and nonpolar), Sigma and Pi bonds with examples.
   2.8 Coordinate covalent bond with examples.

3. Physical States of Matter
   3.1 Physical states of matter, explanation with the help of kinetic molecular theory.
   3.2 Properties of liquids; surface tension, viscosity, capillary action, diffusion.
   3.3 Behavior of gases, kinetic theory of gases.
   3.4 Boyle’s and Charles law, general gas equation, problems relating to these laws.
   3.5 Graham’s low of diffusion, Dalton’s law of partial pressures and Gay Lussac law.
   3.6 Isomorphism and polymorphism.
   3.7 Amorphous solids.

   4.1 Combination reactions.
4.2 Decomposition reactions.
4.3 Displacement reactions
4.4 Double displacement reactions.
4.5 Oxidation and reduction reactions.

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<td>Metals and Alloys</td>
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<td>5.1</td>
<td>Metals and non-metals</td>
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<td>5.2</td>
<td>Important ores; properties and uses of Cu, Al, Zn, and Fe Metals.</td>
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<td>5.3</td>
<td>Corrosion; Definition, causes and control.</td>
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<tr>
<td>5.4</td>
<td>Alloys; introduction.</td>
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<td>5.5</td>
<td>Compositions, properties, and uses of bell metal, stainless steel, and brass.</td>
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<td>6.</td>
<td>Water</td>
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<tr>
<td>6.1</td>
<td>Sources, chemical nature, and properties of water.</td>
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<td>6.2</td>
<td>Impurities of water.</td>
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<td>6.3</td>
<td>Hardness of water.</td>
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<td>7.</td>
<td>Solutions and Colloids</td>
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<td>7.1</td>
<td>Types of Solutions.</td>
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<td>7.2</td>
<td>Concentration.</td>
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<td>7.3</td>
<td>Solubility.</td>
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<td>7.4</td>
<td>Colloids.</td>
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<tr>
<td>8.</td>
<td>Acid and Base</td>
<td>5</td>
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<tr>
<td>8.1</td>
<td>Concept of acid and base.</td>
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<tr>
<td>8.2</td>
<td>Properties of acid and base.</td>
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<tr>
<td>8.3</td>
<td>Strength of acid and base.</td>
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<td>9.</td>
<td>Halogens</td>
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<tr>
<td>9.1</td>
<td>Introduction to halogens.</td>
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<tr>
<td>9.2</td>
<td>Preparation, properties, and uses of Chlorine.</td>
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<tr>
<td>9.3</td>
<td>Preparation, properties, and uses of HCl.</td>
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<tr>
<td>10.</td>
<td>Thermo chemistry</td>
<td>6</td>
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<tr>
<td>10.1</td>
<td>Introduction.</td>
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<tr>
<td>10.2</td>
<td>Exothermic and endothermic reactions.</td>
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</table>
10.3 Heat of reaction.
10.4 Heat of formation.
10.5 Heat of combustion.
10.6 Heat of neutralization.
10.7 Hess’s law of constant heat summation.

11. Electrochemistry 6 Hours
11.1 Theory of ionization.
11.2 Solubility product.
11.3 Electrolytes and electrolysis.
11.4 Faraday’s laws of electrolysis.
11.5 Conductivity of electrolytes.
11.6 pH of solutions and pH scale.
11.7 Measurement of pH.

12. Hydrocarbons 4 Hours
12.1 Introduction to hydrocarbons.
12.2 Classification of hydrocarbons.

BOOKS RECOMMENDED
Dr. RehmanChaudhry, Dr. zafar Iqbal , Dr. M.Munawar Iqbal, etc., “Text Book Of Chemistry for class XI”, Chohan Book Depot, Urdu bazaar Lahore.
1. B.S. Bhal,G.D. Tuli “Essentials of Physical Chemistry”.
2. “Vogel’s Textbook of Quantitative Analysis , Including Elementary Instrumental Analysis”,
PRACTICALS
96 HOURS

1. To study the working of Bunsen burner.
2. To study some elementary operations in glass blowing.
3. To weigh the chemicals on an analytical balance use of sensitive analytical balance.
4. To separate the ingredients of the given mixtures (sand and NaCl, alcohol and water, etc.)
5. To obtain distilled water from river water.
6. To determine the hardness of water.
8. To determine the Melting Points of given solids.
9. To determine the Boiling Points of given liquids.
10. To determine the specific gravity of given liquids such as different oils and other chemical compounds.
11. To determine the viscosity of given liquids by a viscometer.
12. To determine the solubility of common salt in water at room temperature.
13. To determine the effect of temperature on solubility.
14. To separate the mixture by sublimation.
15. To obtain alcohol from a mixture of alcohol and water by distillation.
16. To determine the equivalent weight of magnesium and (to verify the law of constant Composition)
17. To determine the standard solutions of alkalis and acids e. g., NaOH, KOH, oxalic acid etc.
18. Prepare approximate solution of H2SO4 and determine its exact molality by titrating it against standard N/10 NaOH.
19. To determine surface tension of given liquids by torsion balance.
20. To verify the Faraday’s law of electrolysis
21. To determine pH of given solutions.

22. To separate the salts by.
   - Sublimation process
   - Filtration process
   - Sedimentation process

23. To study the analysis scheme.
24. Detection of acidic and basic radicals of salts.
Chem-133 INSTRUCTIONAL OBJECTIVES

1. Understand Basic Concepts of Chemistry.
   1.1 Describe the importance of chemistry in petroleum and chemical industries.
   1.2 Distinguish between element, compound, and mixture.
   1.3 Define atom, molecule, valency, variable valency, atomic weight, and molecular weight with examples of each.
   1.4 Define symbol, formula, and equation with examples of each. Give chemical formula of some common compounds used in petroleum industry.
   1.5 Distinguish between molecular formula and empirical formula.
   1.6 Write molecular formula of different compounds.
   1.7 Write empirical formula of different compounds.
   1.8 Distinguish between physical changes and chemical changes.
   1.9 Differentiate between physical properties and chemical properties.
   1.10 Define acid, base, and salt with examples of each.
   1.11 State the law of conservation of mass, law of constant proportions, law of reciprocal proportions, law of multiple proportions, and solve problems based on these laws.

2. Understand Structure of Atom and Chemical Bonding.
   2.1 Describe the characteristics properties of fundamental particles of atom
   2.2 Explain the various aspects of Bohr’s model of atom and defects of this model.
   2.3 Define energy levels, sub-energy levels, and orbitals.
   2.4 State the rules for the distribution of electrons. Write the electronic configuration of atoms of different elements.
   2.5 Define ionization potential, electronegativity, and electron affinity with examples of each.
   2.6 Define chemical bond and give its types.
   2.7 Describe ionic bond, covalent bond, and coordinate covalent bond.
   2.8 Differentiate between polar bond and nonpolar bond, sigma and pi bond with examples of each.

   3.1 Explain the kinetic molecular theory.
   3.2 Explain the physical states of matter with the help of kinetic molecular theory.
   3.3 Explain kinetic theory of gases.
   3.4 Describe temperature effect on gases.
   3.5 State Boyle’s law.
   3.6 State Charle’s law.
   3.7 Describe absolute temperature.
   3.8 Derive gas equation.
   3.9 Solve problems based on gas equation.
   3.10 State Graham’s Law of Diffusion.
   3.11 Explain Dalton’s law of partial pressures.
   3.12 State Gay Lussac law.
   3.13 Solve problems based on Graham’s law of diffusion and Gay Lussac law.
   3.14 Enlist important properties of liquids.
3.15 Define viscosity.
3.16 Give units of viscosity in different systems of units.
3.17 Enlist methods of measurement of viscosity of liquids.
3.18 Explain method of measurement of viscosity by Oswald’s Viscometer.
3.19 Describe temperature effect on viscosity.
3.20 Describe surface tension.
3.21 Name the units of surface tension.
3.22 Enlist methods for the measurement of surface tension.
3.23 Explain measurement of surface tension by Torsion Balance.
3.24 Explain capillary action of liquids.
3.25 Explain diffusion of liquids.
3.26 Explain density and give units of density.
3.27 Describe effect of temperature on volume of solids.
3.28 Define isomorphism, polymorphism, lattice energy, and amorphous solids.

4. Understand the Chemical Reactions
4.1 Define chemical reaction.
4.2 Write the types of chemical reactions.
4.3 Explain combination reaction, decomposition reaction, displacement reaction, double displacement reaction, oxidation and reduction reaction with examples of each.

5. Understand the Nature and Importance of Metals and Alloys
5.1 Define metals.
5.2 Distinguish between metals and non-metals giving examples of each.
5.3 Describe the properties and uses of Cu, Al, Zn, and Fe.
5.4 Define corrosion.
5.5 State the causes of corrosion and methods to control corrosion.
5.6 Define ores.
5.7 Enlist the important ores of Cu, Al, Zn, and Fe.
5.8 Define alloys.
5.9 Give examples of alloys with their composition.
5.10 Enlist general properties of alloys.
5.11 State uses of alloys.
5.12 Give composition and uses of German silver, bronze, stainless steel, and Nichrom.
5.13 Define Amalgam and Solder.
5.14 Give composition and uses of Bell Metal and Solder.

6. Understand the Chemical Nature and Impurities present in water
6.1 Enlist water sources.
6.2 Describe water and state its physical and chemical properties.
6.3 Name the common impurities (minerals) present in water.
6.4 Define hard water.
6.5 Define soft water.
6.6 Explain causes of hardness.
6.7 Explain removal of permanent hardness by different methods.
6.8 Explain removal of temporary hardness by different methods.

7. Understand the solution and colloidal state of Matter
7.1 Describe solution and its properties.
7.2 Name types of solutions.
7.3 Give examples of different types of solutions.
7.4 Describe various units of concentration.
7.5 Explain ideal and non-ideal solutions giving examples of each.
7.6 Define solubility.
7.7 Describe the factors affecting solubility.
7.8 Distinguish between colloids and true solutions.
7.9 Describe types and general properties of colloids.

8 Understand acids and bases
8.1 Define acid.
8.2 Distinguish between acid and base
8.3 Describe general properties of acids
8.4 Give examples of strong and weak acids
8.5 Give examples of strong and weak bases
8.6 Define acidity
8.7 Define basicity
8.8 Calculate acidity and basicity

9. Understand the Halogens
9.1 Define halogens.
9.2 Describe preparation, Properties, and uses of chlorine.
9.3 Describe preparation, Properties, and uses of HCl.

10 Understand Thermo chemistry
10.1 Define thermo chemistry
10.2 Distinguish between exothermic and endothermic reactions
10.3 Give examples of exothermic and endothermic reactions
10.4 Explain heat of reaction
10.5 Enlist factors affecting heat of reactions
10.6 Describe heat of formation
10.7 Explain heat of combustion.
10.8 Enlist applications of heat of combustion.
10.9 Describe heat of neutralization.
10.10 State Hess’s Law of constant heat summation.
10.11 Solve problems based on Hess’s Law.

11. Understand Electrochemistry
11.1 Describe electrolytes.
11.2 Describe the main postulate of Arrhenius theory of electrolytic dissociation.
11.3 Describe solubility product.
11.4 Describe conductivity of electrolytes.
11.5 Explain effect of dilution on conductivity.
11.6 Explain the process of electrolysis with examples.
11.7 State and explain the faraday’s laws of electrolysis
11.8 Use Faraday’s laws to solve related numerical problems
11.9 List the application of electrolysis
11.10 Describe electroplating
11.11 Explain pH of solutions and pH scale
11.12 Describe the methods to measure pH of solutions
11.13 Explain the buffer solutions

12. Understand Hydrocarbons
12.1 Define hydrocarbons and give examples of hydrocarbons

12.2 Enlist main classes of hydrocarbons and their nomenclature according to IUPAC system

12.3 Describe the following classes of hydrocarbons
   12.3.1 Paraffin series
   12.3.2 Olefin series
   12.3.3 Naphthalene series
   12.3.4 Aromatic series
   12.3.5 Diolefin
   12.3.6 Isomeric compounds
COMP-142

COMPUTER APPLICATIONS

Total Contact Hours

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<td>Practical</td>
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Pre-requisite: None

AIMS: This subject will enable the student to be familiar with the fundamental concepts of Computer Science. He will also learn MS-Windows, MS-Office, and Internet to elementary level.

Detail of Contents:

1. **Electronic data processing (E.D.P.)** 6 Hours
   1.1 Basic Terms of Computer Science Data & its types, Information, Hardware, Software
   1.2 Computer & its types
   1.3 Block diagram of a computer system
   1.4 BIT, Byte, RAM & ROM
   1.5 Input & Output devices
   1.6 Secondary storage devices
   1.7 Types of Software
   1.8 Programming Languages
   1.9 Applications of computer in different fields
   1.10 Application in Engineering, Education & Business

2. **MS-Windows** 2 Hours
   2.1 Introduction to Windows
   2.2 Loading & Shut down process
   2.3 Introduction to Desktop items (Creation of Icons, Shortcut, Folder & modify Taskbar)
   2.4 Desktop properties
   2.5 Use of Control Panel
   2.6 Searching a document

3. **MS-Office (MS-word)** 8 Hours
   3.1 Introduction to MS-Office
   3.2 Introduction to MS-Word & its Screen
3.3 Create a new document
3.4 Editing & formatting the text
3.5 Saving & Opening a document
3.6 Page setup (Set the Margins & Paper)
3.7 Spell Check & Grammar
3.8 Paragraph Alignment
3.9 Inserting Page numbers, Symbols, Text box & Picture in the document
3.10 Use the different Format menu drop down commands
   (Drop Cap, Change Case, Bullet & Numbering and Border & Shading)
3.11 Insert the Table and it's Editing
3.12 Printing the document
3.13 Saving a document file as PDF format

4. MS-office (MS-excel)  9 Hours
4.1 Introduction to MS-Excel & its Screen
4.2 Entering data & apply formulas in worksheet
4.3 Editing & Formatting the Cells, Row & Colum
4.4 Insert Graphs in sheet
4.5 Page setup, Print Preview & Printing
4.6 Types & Categories of Charts

5. Office (MS-power point)  4 Hours
5.1 Introduction to MS-Power point
5.2 Creating a, presentation
5.3 Editing & formatting a text box
5.4 Adding pictures & colors to a slide
5.5 Making slide shows
5.6 Slide Transition

6. Internet & e-mail  3 Hours
6.1 Introduction to Internet & browser window
6.2 Searching, Saving and Print a page from internet
6.3 Creating, Reading & Sending E-Mail
6.4 Explain some advance features over the internet and search engines

**Recommended Textbooks:**
1. Bible Microsoft Office 2007 by John Walkenbach
2. Bible Microsoft Excel 2007 by John Walkenbach
3. Bible Microsoft PowerPoint 2007 by John Walkenbach
1. **Understand electronic data processing (E.D.P)**
   1.1. Describe Basic Terms of Computer Science, Data & its Types, Information, Hardware, Software
   1.2. Explain Computer & its types
   1.3. Explain Block diagram of a computer system
   1.4. State the terms such as BIT, Byte, RAM & ROM
   1.5. Identify Input & Output devices
   1.6. Describe Secondary Storage devices
   1.7. Explain Types of Software
   1.8. Introduction to Programming Language
   1.9. Explain Applications of computer in different fields
   1.10. Application in Engineering, Education & Business

2. **Understand ms-windows**
   2.1 Explain Introduction to Windows
   2.2 Describe Loading & Shut down process
   2.3 Explain Introduction to Desktop items (Creation of Icons, Shortcut, Folder & modify Taskbar)
   2.4 Explain Desktop properties
   2.5 Describe Use’ of Control Panel (add/remove program, time & date, mouse and create user account)
   2.6 Explain the method of searching a document

3. **Understand ms-office (MS-word)**
   3.1 Explain Introduction to MS-Office
   3.2 Describe -Introduction to MS-Word & its Screen
   3.3 Describe create a new document
   3.4 Explain Editing & formatting the text
   3.5 Describe saving & Opening a document
   3.6 Explain Page setup, (Set the Margins & Paper)
   3.7 Describe Spell Check & Grammar
   3.8 Explain Paragraph Alignment
   3.9 Explain Inserting Page numbers, Symbols, Text box & Picture in the document
   3.10 Describe Use the different Format menu drop down commands (Drop Cap, Change
3.11 Explain Insert the Table and its Editing and modifying
3.12 Describe printing the document
3.13 Describe the method of file saving as a PDF Format

4. Understand ms-office (MS-excel)
   4.1 Explain Introduction to MS-Excel & its Screen
   4.2 Describe Entering data & apply formulas in worksheet
   4.3 Describe Editing &Formatting the, Cells, Row & Column
   4.4 Explain Insert Graphs in sheet
   4.5 Describe Page setup, Print preview & Printing
   4.6 Explain in details formulas for sum, subtract, multiply, divide, average
   4.7 Explain in details the types of charts e.g pie chart, bar chart

5. Understand ms-office (MS-power point)
   5.1 Describe Introduction to MS-Power point
   5.2 Explain creating a presentation
   5.3 Describe Editing & formatting a text box
   5.4 Explain Adding pictures & colors to a slide
   5.5 Describe Making slide shows
   5.6 Explain Slide Transitions

6. Understand internet &e-mail
   6.1 Explain Introduction to Internet and browser window
   6.2 Explain Searching, Saving and Print a page from internet
   6.3 Describe Creating, Reading & Sending E-Mail and attachments
   6.4 Explain some advance features over the internet and how to search topics on different search engines
List of Practical:

1. Identify key board, mouse, CPU, disk drives, disks, monitor, and printer and 3Hrs

2. WINDOWS XP
   2.1 Practice of loading and shutdown of operating system
   2.2 Creating items (icons, shortcut, folders etc) and modifying taskbar
   2.3 Changing of wallpaper, screensaver, and resolution
   2.4 Practice of control panel items (add/remove, time and date, mouse, and create user account)

3. OFFICE (MS-WORD) 27 Hrs
   3.1 Identifying the MS Word Screen and its menu
   3.2 Practice of create a new document, saving and re-opening it from the location and spell check & grammar
   3.3 Practice of Page Formatting (Borders, Character Spacing, Paragraph, Bullets & Numberings and Fonts)
   3.4 Practice of different tool bars like standard, format & drawing tool bars
   3.5 Practice of Insert pictures, clipart, and shapes
   3.6 Practice of header and footer
   3.7 Practice of insert table and also format of table
   3.8 Practice of page setup, set the page margins, and printing documents

4. OFFICE (MS-EXCEL) 27 Hrs
   4.1 Identifying the MS EXCEL Screen and its menu
   4.2 Practice of create a new sheet, saving and re-opening it from the location and spell check
   4.3 Practice of insert and delete of row and columns (format of cell)
   4.4 Practice of entering data and formulas in worksheet (Add, Subtract, Multiplying, and Divide & Average)
   4.5 Repeating practical serial number 04
   4.6 Practice of insert chart and its types
   4.7 Practice of page setup, set the page margins, and printing

5. OFFICE (MS-POWER POINT) 15 Hrs
   5.1 Identifying the MS POWER POINT Screen and its menu
   5.2 Practice of create a new presentation and save
   5.3 Practice of open saves presentations
   5.4 Practice of inset picture and videos
NET & E-MAIL

6.1 Identifying internet explorer
6.2 Practice of searching data from any search engine
6.3 Practice of create an E-Mail account and how to send and receive E-mails, download attachments
PCT-103 BASIC ENGINEERING DRAWING & AutoCAD

Total Contact Hours

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<th>T</th>
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<tr>
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<tr>
<td>Practical:</td>
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Pre-requisites: None

Course Objectives: At the end of this course the students will be able to understand the Fundamentals of Engineering Drawing used in the various fields of industry. The students will be familiarizing with the use of conventional drawing equipments as well as the modern techniques used for this subject. Also the will be familiarize with AutoCAD and will achieve ability to draw simple geometrical figures and two/three dimensional drawing of objects.

Detail Course Contents:

PART-A Manual Drawing

1. Application of Technical Drawing
   1.1 Importance of Technical Drawing
   1.2 Language of engineering terminology
   1.3 Uses of Technical Drawing
   1.4 Type of Drawing
   1.5 Application of Technical drawing

2. Drafting Equipments, Construction Uses, and Care
   2.1 Introduction and importance of drafting equipments
   2.2 List of drawing equipments
   2.3 Construction, uses and care of all equipment
   2.4 Drafting board, Table and machine
   2.5 Tee, Triangles and protractors
   2.6 Instruments Box and its accessories
   2.7 Drawing Pencil, their grading, sharpening and using techniques
   2.8 Scale and its types

3. Types of Lines
   3.1 Basic lines
   3.2 Importance of lines
   3.3 Common Types of lines
   3.4 Uses and correct line weight age
   3.5 Use of pencil for different lines
   3.6 Application of lines
   3.7 Objectives in drafting

4. Lettering
   4.1 Importance of a good lettering
<table>
<thead>
<tr>
<th>Chapter</th>
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<tr>
<td>4.2</td>
<td>General Proportion of lettering</td>
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<td>4.3</td>
<td>Composition of letters</td>
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<td>4.4</td>
<td>Guide lines</td>
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<td>4.5</td>
<td>Classification of lettering</td>
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<td>4.6</td>
<td>Style of letters</td>
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<td>4.7</td>
<td>Lettering devices</td>
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<tr>
<td>5</td>
<td>Drafting Geometry</td>
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<tr>
<td>5.1</td>
<td>Introduction to geometry, plane and solid type</td>
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<tr>
<td>5.2</td>
<td>Definition of terms</td>
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<tr>
<td>5.3</td>
<td>Different conventional shapes, surfaces and objects</td>
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<td>5.4</td>
<td>Basic geometrical construction</td>
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<td>Sketching and shape description</td>
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<td>6.1</td>
<td>Introduction to sketching techniques</td>
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<td>6.2</td>
<td>Techniques of sketching straight lines in different directions</td>
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<td>6.3</td>
<td>Sketching circles and arcs</td>
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<td>6.4</td>
<td>Sketching Ellipse</td>
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<td>6.5</td>
<td>Sketching of pictorial views</td>
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<td>Proportions in sketching</td>
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<td>7</td>
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<td>Application of engineering curves</td>
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<td>7.3</td>
<td>Cone and conic section</td>
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<td>7.4</td>
<td>Spiral and Involutes</td>
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<td>7.5</td>
<td>Cycloid, Epicycloids, Hypocycloid</td>
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<td>Introduction to multi-view drawings</td>
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<td>8.1</td>
<td>Introduction to the plane and its types</td>
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<td>Dihedral and Trihedral angles</td>
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<td>8.3</td>
<td>Projection of point, lines, plane and solids</td>
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<td>Definition and concept of multi-view drawings</td>
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<td>Perceptual views of plan of projections</td>
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<td>Orthographic projections</td>
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<td>8.7</td>
<td>1st angle and 3rd angle projection</td>
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<td>8.8</td>
<td>Principal views and its arrangements</td>
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<td>8.9</td>
<td>Multi-view drawings and missing lines</td>
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<tr>
<td>9</td>
<td>Introduction to Pictorial drawing</td>
<td>4Hrs</td>
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<td>9.1</td>
<td>Uses of pictorial /3D</td>
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<td>9.2</td>
<td>Three types of pictorial views</td>
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<td>9.3</td>
<td>Isometric sketching of rectangular block with Arcs and circles</td>
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<td>9.4</td>
<td>Oblique sketching of rectangular block</td>
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<td>9.5</td>
<td>One point perspective sketching of rectangular block</td>
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<td>9.6</td>
<td>Two points perspective sketching of rectangular block</td>
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<td>9.7</td>
<td>Preparation of pictorial drawings of simple objects</td>
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<td>10</td>
<td>Dimensioning</td>
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<td>10.1</td>
<td>Definition of dimensioning</td>
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10.2. Types of dimensioning
10.3. Elements of dimensioning
10.4. System of measurements
10.5. Dimensioning of multi view drawing
10.6. Dimensioning pictorial views
10.7. Dimensioning rules and practices
10.8. Note & specification

11. Introduction to multi-view drawings
11.1. Introduction to the surface development
11.2. Role of development in Packaging Industry
11.3. Methods to develop the surfaces
11.4. Geometrical solids and development

PART- B AutoCAD

12. Introduction of AutoCAD
12.1. Various Computer Aided Drawing Softwares
12.2. User Interface
12.3. Template
12.4. Layers and Object
12.5. Mechanical Structure

13. Drawing and Edit
13.1. Object Snap
13.2. Drawing Command
13.3. Edit Command
13.4. Object Command

14. Layers
14.1. Layers

15. Dimension and Symbols
15.1. Create Dimension
15.2. Edit Dimension
15.3. Create Symbols

16. Drawing Layout
16.1. Make Layout
16.2. Create Drawing Frame
16.3. Create Contents and Template

**Recommended Textbooks:**

1. French. Svensen, Helsel and Urbanick,” Mechanical Drawing” (12th Addition)
2. Scot. Foy, Schwendan,”Drafting Fundamentals”,

43
4. Colinsimmous, Dennis Maguire, ”Engineering Drawing”,
5. Frederik E. Alva. Henry Cecil, ”Technical Drawing”
6. R.K. Dhawan, ”Text Book of machine Drawing”,
7. M.B. Shah (B.C.Rana), ”Engineer Drawing”
List of Practical:

Part-A Manual Drawing

1. Practice of single stroke capital vertical & inclined lettering
2. Double stroke lettering
3. Use of Tee-square and set squares for drawing horizontal, vertical and inclined lines
4. Use of compass, circles, half circles, radius
5. Use of Tee-square and compass for drawing of lines, centers, curves, and crossing of lines
6. Draw round corners, figure inside and outside circle
7. Construction of angles and triangles
8. Construction of quadrilaterals and circles elements
9. Construction of parallel-lines, perpendicular, bisects line, angles and equal division of lines
10. Construction of inscribe and circumscribe figures (square, triangle and hexagon)
11. Construction of pentagon by different methods
12. Construction of Hexagon, Octagon, by general and different methods
13. Construction of Tangents of circles (Inside & Outside)
14. Construction of Ellipse by four different methods
15. Construction of parabola curve by four different methods
16. Construction of hyperbola curve
17. Construction of involutes curve of square rectangle hexagon and circle
18. Construction of cycloid, epicycloids, and hypocycloid
19. Different types of drawing lines
20. Orthographic projection 1 and 3rd angle wooden block-1
21. Orthographic projection 1 and 3rd angle wooden block-2
22. Orthographic projection and Isometric Drawing-I
23. Orthographic projection and Oblique Drawing-I
24. Construction of perspective drawings. (One point)
25. Construction of perspective drawings. (Two point)
26. Construction of multi view drawing of Gland
27. Construction of multi view drawing of Simple Bearing
28. Construction of multi view drawing of Open Bearing
29. Development of prism-I
30. Development of cylinder
31. Development of cone
32. Development of pyramid-I

Part-B AutoCAD

1. Starting AutoCAD
2. Title Bar, Tool Bar, Menu Bar, Browser, Status Bar, Command Line
3. Zoom, Pan, Orbit
4. Object Snap, Grid, Orthogonal
5. Layer and Object Property
6. Construction Line and Center Line
7. Line and Poly line Command
8. Circle, Arc and Ellipse Command
9. Rectangular and Polygon Command
10. Dimension and Hatching
11. Text Command
12. Copy, Mirror Command
13. Offset Command
14. Move, Rotate and Scale Command
15. Trim and Extend Command
16. Join and Break Command
17. Fillet and Chamfer Command
18. Explode Command
19. Exercise of Basic Drawings
20. 2-D drawings and commands
21. Practice Draw Commands
22. Practice Modify Commands
23. Understand Selecting Objects
24. Understand Object Properties
25. Understand Drafting Settings and Object Snaps
26. Practice Dimensions and Text Tools
27. Understand User Coordinate System (UCS) and the Z-axis
28. Practice 3D Wireframe Modeling and mesh
29. Understand UCS, Viewports and Wireframe Modeling
30. Practice 3D Surface Modeling
31. Practice Solid Modeling - Constructive Solid Geometry
32. Practice Multi-view Drawings from 3D Models
Instructional Objectives:

Part-A

1. **Know the application of Technical Drawing**
   1.1 Describe the technical drawing and its importance
   1.2 Describe the role of Inventor, Engineer, Designer, Technician, Craftsman etc.
   1.3 Describe the uses of drawing in manufacturing and construction fields
   1.4 Describe the free hand and instrumental drawing
      1.4.1 Explain the types of instrumental drawing
      1.4.2 Describe Multi-view, Pictorial and Schematic drawing
   1.5 Recognize the different application of technical drawing

2. **Know and use the common Drafting equipment and accessories**
   2.1 Explain the introduction and importance of drafting equipments
   2.2 Identify the different instruments used in drafting
   2.3 Describe the construction, uses and care of all equipments
   2.4 Describe the Drafting Board, Table and Drafting machine
   2.5 Explain the Tee, Triangles and Protractor
   2.6 Describe the Compasses Divider, Lengthening Bar, Attachments etc.
   2.7 Describe the use of pencils, their Grading and sharpening techniques
   2.8 Explain the scale and its different types

3. **Understand the Types of lines, correct weight age and their application in technical drawings**
   2.9 Describe the point, line and types of straight lines
   2.10 Describe the importance of lines
   2.11 Describe the common types of lines
   2.12 Identify the each line Characteristics
   2.13 Describe Horizontal, Vertical and inclined lines with proper grade pencil
   2.14 Describe each line with his correct weight
   2.15 Describe the objectives in drafting, Accuracy, Speed, Legibility and Neatness

4. **Applies the good lettering on a drawing**
   4.1 Know the importance of good lettering in Engineering drawing
   4.2 Know the general proportion of lettering such as normal, condensed and extended lettering
   4.3 Describe and Identify the composition of letters
      4.3.1 Perform the best spacing between letters and words
      4.3.2 State the size and stroke of a letter
   4.4 Describe the Gide lines
   4.5 Describe the Gothic, Roman and free hand lettering
      4.5.1 Print single stroke, Double stroke lettering, Light face, Bold face lettering, Upper case, Lowe case lettering
   4.6 Print vertical and Inclined style of Gothic lettering
      4.6.1 State the proper pencil for lettering with holding techniques
      4.6.2 Describe the general rules for lettering
   4.7 Describe and use of different lettering devices such as lettering guide and lettering instrument
5. Apply drawing skill with the aid of drawing instruments in geometrical construction
   5.1 Define the concept of common terms used in Geometrical construction
   5.2 Explain different geometrical shapes, surfaces of objects
   5.3 Bisecting a line, angles
   5.4 Describe basic geometrical constructions
      5.4.1 Define Triangles, Quadrilateral, Polygons
      5.4.2 Name and draw the parts of circle

6. Understand sketching of circles, arcs and view of objects
   1.1 Describe sketching material
   1.2 State Sketching Technique of Horizontal, Vertical and inclined lines
   1.3 Describe circular arc using circular line method
      1.3.1 Draw a circular arc using square method
   1.4 Draw an ellipse using rectangular method
   1.5 Described the sketching of pictorial views
   1.6 Proportions in sketching of views
      6.6.1. Enlargement and Reduction

7. Know and draw the different Engineering Curves used in various mechanism
   7.1. Describe the different engineering curves
   7.2. Describe the application of different Engineering curves
   7.3. Define cone and conic sections
      7.3.1 Describe the Ellipse, Parabola & Hyperbola by different methods
   7.4. Define the Archimedean Spiral and involutes
      7.4.1 Define the Involute curves of square, Triangle, Circle and Hexagon
   7.5. Describe the Cycloid curves
      7.5.1 Define Cycloid, Epicycloids and Hypocycloid curves

8. Understand the multi-view projections of specific object
   8.1. Describe the plane and its types
   8.2. Define Dihedral and Trihedral angles
   8.3. Explain the projection of point, lines, plane and solids in different shapes
   8.4. Define the concept of multi-view drawings
   8.5. Knows Plane of projections
   8.6. Know the orthographic method of projection
   8.7. Explain the 1st and 3rd angle projections
   8.8. State six principal views
   8.9. Practice of multi-view projections and missing lines

9. Apply the use, types and methods of pictorial views
   9.1. Describe the importance of pictorial views
   9.2. State three types of pictorial drawings
   9.3. Describe isometric view of rectangular blocks, arcs, circles
   9.4. Describe oblique sketching of a rectangular blocks
   9.5. Describe one point perceptive view of rectangular block
   9.6. Describe two point perspective view of a rectangular block
   9.7. Prepare/draw pictorial drawings of simple objects

10. Apply good dimensioning on multi-view and pictorial drawings
   10.1. Define dimensioning
   10.2. Identify the types of dimensioning
   10.3. Enlist the elements of dimensioning
   10.4. Identify the system of measurements
   10.5. Indicate complete dimension on multi-view drawings
   10.6. Indicate complete dimension on pictorial drawings
10.7. Follow the general rules of dimensioning
10.8. Indicate notes and specification or multi-view drawings

11. Know the surface development and their procedure to develop and its role in packing industry
   11.1. Define the surface development
   11.2. Explain the role of development in Packaging Industry
   11.3. Describe the methods to draw the development
       11.3.1. Parallel line or Rectangle method
       11.3.2. Radial line or Triangle method
       11.3.3. Triangulation method
   11.4. Define and draw the different Geometrical solids and their development.

Part-B

12. Introduction of AutoCAD
   12.1. User Interface
   12.2. Understand Template
   12.3. Understand Layers and Object
   12.4. Understand Mechanical Structure

13. Drawing and Edit
   13.1. Understand the Object Snap
   13.2. State the Drawing Command
   13.3. Understand the Edit Command
   13.4. Describe the Object Command

14. Layers
   14.1. Describe the creation and modifying Layers

15. Dimension and Symbols
   15.1. Understand create Dimension
   15.2. Understand create editing Dimension
   15.3. Understand create Symbols

16. Drawing Layout
   16.1. Understand creation of Layout
   16.2. Understand creation of Drawing Frame
   16.3. Understand creation of Contents and Template
PCT-113 FUNDAMENTALS OF PETROLEUM TECHNOLOGY

Total Contact Hrs. T P C
Theory 64 2 3 3
Practical 96

Course Objectives: After studying this course, students will be able to
1. Understand primary and secondary quantities related to Petroleum Technology.
2. Understand earth rocks and their age.
3. Explain properties of reservoir rock and petroleum fluids.
4. Understand the composition of Petroleum Crudes and its Refining.
5. Know the application of petroleum products.
6. Know some analytical techniques used during drilling operation.

Detail of Course Contents:

1. Units of Measurement. 10 Hours
   1.1 SI System of units and other derived units.(primary and secondary)
   1.2 Conversion of units.
   1.3 Large and small measures.
   1.4 Laboratory and field units.
   1.5 Simple derived units.
   1.6 Temperature.
   1.7 Pressure, standard and atmospheric.
   1.8 Multiple derived units, Examples.
   1.9 Graphing.

2. Origin and composition of petroleum 10 Hours
   1.1 Introduction to petroleum technology
   1.2 The origin of petroleum.
   1.3 The composition of petroleum
   1.4 Introduction to petroleum Geology
   1.5 Main division of rocks of the earth.
   1.6 Rock Structure (faults and folds).
   1.7 Sediments formation.
   1.8 Unconformity
   1.9 Types of sedimentary rocks and their properties
   1.10 Petroleum source and reservoir rocks.

3. Geophysical Exploration 6 Hours
   3.1 Early techniques.
   3.2 Magnetic Survey.
   3.3 Gravity Survey.
   3.4 Seismic survey.

4. Reservoir Studies 10 Hours
4.1 Reservoir classification
4.2 Types of reservoir fluids
4.3 Initial reservoir pressure
4.4 Natural/Primary production mechanisms.
4.5 Secondary Recovery.
4.6 Reservoir Fluid Sampling.
4.7 Subsurface Pressure.
4.8 Subsurface Temperature.

5. Properties of Liquid and Gaseous Petroleum Products. 08 Hours
   5.1 Properties of liquid petroleum Products
   5.2 PVT Properties.
   5.3 API gravity.
   5.4 Bubble point pressure.
   5.5 Formation volume factor.
   5.6 Solution gas-oil-ratio.
   5.7 Oil viscosity.
   5.8 Flash and differential vaporization.
   5.9 Properties of gaseous petroleum Products.
   5.10 Wet gas and dry gas.
   5.11 Sour gas and Sweet gas.
   5.12 Gas gravity.
   5.13 Standard conditions.
   5.14 Compressibility of fluids.

6. Reservoir Pore Space and Fluid flow. 08 Hours
   6.1 Porosity.
   6.2 Classification of porosity.
   6.3 Typical porosity values.
   6.4 Permeability.
   6.5 Darcy’s equation and solve related numerical.

7. Drilling 04 Hours
   7.1 Introduction to oil and gas well drilling.
   7.2 Drilling rig and its components

8. Production 04 Hours
   8.1 Introduction to petroleum production.
   8.2 Brief Idea about Surface and Subsurface Equipment.

9. Petroleum Refining and Petrochemicals 04 Hours
   9.1 Introduction to petroleum refining.
   9.2 Main processes of Refinery.
   9.3 Introduction to petrochemicals.
   9.4 Importance of Petrochemicals in daily life.
PCT-113 List of Practical:

1. Plotting different types of graphs: cartesian, semi log, log-log.
2. Identification of different types of rocks; igneous, metamorphic, sedimentary.
3. Identification of various types of sedimentary rocks; sandstone, shale, limestone and dolomite.
4. Draw sketches and study various types of faults.
5. Draw Sketches and study various types of folds.
6. Determine the specific gravity of various crude oil samples by means of hydrometers and calculate API gravity of each sample at laboratory temperature and pressure conditions.
7. Determine the viscosity of crude oil samples by Saybolt viscometer.
8. Determination of bulk volume from measurement of the dimensions of the uniformly shaped rock samples; cylindrical cores, rectangular cores.
9. Determination of bulk volume by volumetric fluids displacement method; coated sample immersed in water.
10. Determination of bulk volume by volumetric fluids displacement method; immersion in Kerosene oil of the core sample saturated with kerosene oil.
11. Gravimetric determination of bulk volume by observing the loss in weight of the core sample when immersed in a liquid (water in case of coated-sample, kerosene oil in case of a sample saturated with kerosene oil).
12. Gravimetric determination of bulk volume by observing the change in weight of a pycnometer when filled with mercury and when filled with mercury and core sample.
15. Dip meter survey.
17. Comparison of properties of petroleum fluids.

Recommended Textbooks:

5. Union Texas Pakistan, Inc. “Production Operator II”.
7. Union Texas Pakistan, Inc., “Production Operator IV”.

52
Instructional Objectives:

1. **Understand the Units of Measurement**
   1.1 Name the different units of measurement.
   1.2 Explain the measurement of flow.
   1.3 State the SI system of units.
   1.4 Describe the derived units.
   1.5 Explain the process of conversion of units. Solve relevant numerical problems.
   1.6 Explain the process of units conversion by an example.
   1.7 Distinguish between large and small measures.
   1.8 Define the simple derived units.
   1.9 Define temperature and give different scales of temperature. Solve relevant numerical problems.
   1.10 Describe the instruments to measure temperature.
   1.11 Define pressure and give its units. Solve relevant numerical problems.
   1.12 Describe various types of pressures.
   1.12.1 Define atmospheric pressure.
   1.12.2 Define absolute pressure.
   1.15 Explain the standard atmosphere.
   1.16 Give the examples of multiples of derived units.
   1.17 Define the main characteristics of multiple derived units.
   1.18 Describe various types of graphs; rectangular graphs, semi-log graphs, log-log graphs.

2. **Understand Origin and Composition of Petroleum**
   2.1 State the commonly accepted concept regarding the origin of petroleum.
   2.2 Discuss composition of petroleum and describe two main families of hydrocarbons of which petroleum is made up.
   2.3 Describe non-hydrocarbon constituents commonly found in crude oils and natural gases.
   2.4 List and describe various Types of Crudes, Naphtha.
   2.5 State the three main divisions of the rocks of the earth.
   2.6 Describe with the help of a diagram the rock cycle and sediment formation.
   2.7 Define geological structure and describe main types of structures; Bedding, Current Bedding, Graded Bedding, Slump Bedding, Ripple Marks.
   2.8 Describe what is meant by unconformity.
   2.9 Define two methods for determining age of rocks.
   2.10 Describe various geological processes; Deposition, Geosynclines, Deltaic deposition.
   2.11 State the types of sedimentary rocks and their properties.
   2.12 Explain various rock structures (faults and folds) and their types with the help of diagrams.

3. **Know the Fundamental Methods of Exploration**
   3.1 Briefly describe the principles of various methods of exploration.
   3.2 Describe Magnetic Survey.
   3.3 Explain Gravity Survey.
   3.4 Describe Seismic survey.
   3.4.1 Explain Reflection Seismic.
   3.4.2 Explain Refraction Seismic.

4. **Understand Basis of Reservoir Studies**
   4.1 Describe classifications of hydrocarbon reservoirs on the basis of the fluids and their physical states.
4.2 Discuss the sources of reservoir pressure and its effects on the reservoir fluids and their production.

4.3 Describe the natural production mechanisms; Water Drive, Solution Gas Drive and Gas Cap Drive.

4.4 Describe the secondary recovery phase of reservoir: water injection, Gas Injection.

4.5 Give introduction to reservoir fluid sampling.

4.6 Describe the aim of sampling and reservoir fluids behavior.

4.7 Describe important features of oil reservoir sampling.

4.8 Briefly describe the sources of subsurface pressures.

5. **Understand Properties of Liquid and Gaseous Petroleum Products**

5.1 Define the silent features of the following properties of liquid petroleum Products.
- LPG and LNG
- API Gravity.
- Bubble Point Pressure.
- The Solution Gas-Oil-Ratio.
- The oil Viscosity.
- Flash and Differential Vaporization.

5.2 Define the salient features of the following properties of gaseous petroleum Products.
- Wet Gas and Dry Gas.
- Sour Gas and Sweet Gas.
- CNG
- Gas Gravity.
- Standard Conditions.

5.3 Describe the gas law. Solve relevant numerical problems.

5.4 Define compressibility factor.

6. **Understand the Reservoir Rock Properties; Porosity, Permeability**

6.1 Define porosity and describe the equation for its calculation.

6.2 Give classification of rock porosity; Absolute Porosity, Effective Porosity.

6.3 Describe classification of porosity according to its mode of origin; Primary Porosity, Secondary Porosity.

6.4 Describe three types of secondary porosity based on mechanism of formation.

6.5 Explain Darcy equation which describes flow of fluid through porous media. Solve relevant numerical problems.

6.6 List the limitations of Darcy’s equation.

7. **Drilling**

7.1 Understand the drilling and state its types.

7.2 Enlist and define different systems of drilling.

7.3 Enlist the main parts of Rotary drilling Rig.

8. **Production**

8.1 Describe the production and production operations.

8.2 State different production operations.

8.3 State surface and subsurface facilities.

9. **Petroleum Refining and Petrochemicals**

9.1 Introduction to petroleum refining.

9.2 State Oil and Gas reserves in Pakistan.

9.3 Describe main processes employed during Petroleum Refining.
- 9.3.1 Define Distillation. Atmospheric and Vacuum.
- 9.3.2 Define Reforming Process.

9.4 State Petroleum Refinery Products.
9.5 Introduction to petrochemicals.
9.6 Enlist importance Petrochemicals used in daily life.

**PCT-124 WORKSHOP PRACTICE**

<table>
<thead>
<tr>
<th>Total Contact Hours</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
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<tbody>
<tr>
<td>Theory:</td>
<td>32Hrs</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Practical:</td>
<td>288Hrs</td>
<td></td>
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</tbody>
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Pre-requisites: None

**Course Objectives:** The students will familiarize with the Tools, Equipment, Machines used in the Pipe Fitting, Metal work, Welding, Basic machine and Wiring shops. The student will achieve the Basic skills in the above fields by preparing specific jobs in each part of the subject.

**Detail of Contents:**

1. Pipes and Pipe Fitting
   1.1 Pipes. 1 Hours
      1.1.1 Piping classification.
      1.1.2 Process lines.
      1.1.3 Utility lines.
      1.1.4 Pipe size.
      1.1.5 Pipe schedule.
      1.1.6 Pipe material; Metallic Piping, Ferrous Piping, Non-ferrous Piping, Plastic Piping, Thermo-plastic Piping, Thermo-setting plastic Piping.
   1.2 Methods of Joining Pipes. 1 Hour
      1.2.1 Welded joints.
      1.2.2 Flanged joints.
      1.2.3 Screwed joints.
      1.2.4 Coupled joints.
   1.3 Pipe Fitting. 2 Hours
      1.3.1 Types of pipe fitting.
      1.3.2 Pipe supports.
      1.3.3 Flared fitting.
      1.3.4 Flare less fitting.
   1.4 Tubing 2 Hours
      1.4.1 Metallic tubing.
      1.4.2 Seamless tubing.
      1.4.3 Welded tubing.
      1.4.4 Methods of joining tubing.
   1.5 Valves 2 Hours
      1.5.1 Valves.
      1.5.2 Types of Valves.

2. General Metal Work
   2.1 Introduction To Metal Work and Metal Working Tools 1 Hr
      2.1.1 Observe safety precautions and proper care of Metal working tools and machines.
      2.1.2 Metals, Non-metals
2.2 Kindsof Toolsand Machines

2.2.1 Hand tools
  2.2.1.1 Measuring tools
  2.2.1.2 Layout tools
  2.2.1.3 Cutting tools
  2.2.1.4 Chisels
  2.2.1.5 Files and Filing
  2.2.1.6 Hacksaws and Hack sawing
  2.2.1.7 Drills & Reamers
  2.2.1.8 Taps, Taping and Threading dies

2.2.2 Machines

2.2.3 Drilling machines
  2.2.3.1 Power Hacksaw
  2.2.3.2 Bending machines
  2.2.3.3 Rolling machine
  2.2.3.4 Shearing machine

2.3 Fasteners

2.3.1 Introduction to Fasteners
2.3.2 Screws, Nuts, Bolts, Rivets,
2.3.3 Types and applications of related tools

3. Welding

3.1 Welding shop Machinery, Tools and Equipments

3.1.1 Definition of welding
3.1.2 Welding Processes
  3.2.2.1 Pressure welding
  3.2.2.2 Fusion welding process
3.1.3 Types of pressure welding process
  3.1.3.1 Forge welding
  3.1.3.2 Resistance welding
  3.1.3.3 Types of Resistance welding
3.1.4 Types of Fusion welding
  3.1.4.1 Oxy acetylene gas welding
  3.1.4.2 Arc welding
  3.1.4.3 Thermo welding
  3.1.4.4 TIG welding
  3.1.4.5 MIG welding
  3.1.4.6 Submerged Arc welding
  3.1.4.7 Argon Welding

3.2 Detail of Fusion Welding (Oxy acetylene gas welding, Arc welding)

3.2.1 Oxy acetylene gas welding
List of Oxy acetylene gas welding tools/equipment with their uses
3.2.2 Arc welding
  3.2.2.1 Introduction to Arc welding machine
  3.2.2.2 List of Arc welding tools equipments with their uses
3.2.3 Welding Materials
  3.2.3.1 Flux
  3.2.3.2 Types of filler rod
  3.2.3.3 Types of Electrode
3.2.4 Safety method in welding shop
   3.2.4.1 Flash back and its remedy
   3.2.4.2 Back fire and its remedy
3.2.5 Welding Defects

4. Basic Machine Shop 8Hrs

Lathe construction
4.1 Parts of lathe
   4.1.1 Lathe accessories
4.2 Lathe cutting tools and materials
   4.2.1 Cutting tools material
   4.2.2 Types of Lathe cutting tools
4.3 Cutting speed and feed
   4.3.1 Cutting speed feed and depth of cut
4.4 Lathe Operations
   4.4.1 Introductions
   4.4.2 Centering of work piece
   4.4.3 Facing
   4.4.4 Straight turning
   4.4.5 Step turning
   4.4.6 Knurling
   4.4.7 Center drilling and drilling
   4.4.8 Taper turning
4.5 Tool Grinder
4.6 Shaper

5. Electrical Wiring Zero Hours

Recommended Textbooks:
PCT-124 WORKSHOP PRACTICE

List of Practical:

1) Pipe and Pipe Fitting
   1. Practice of threading.
   2. Practice of thread cutting.
   3. Practice of short nipple.
   4. Practice of classed nipple.
   5. Practice of long nipple.
   6. Practice of union fitting of metallic pipes and plastic pipes.
   7. Practice of elbow fitting of plastic pipes and metallic pipes.
   8. Practice of joining the metallic and plastic pipes.
      i) Practice of welded joints.
      ii) Practice of flanged joints.
      iii) Practice of served joints.
      iv) Practice of coupled joints.
   9. Compression and are fitting.
   10. Practice of tubing and joining tubing.
      i) Practice of metallic tubing.
      ii) Practice of seamless tubing.
      iii) Practice of welded tubing.
      iv) Practice of flange joint for glass pipes.

2) General Metal Work
   1. Preparation of name plate
   2. Sawing exercise
   3. Preparation of inside caliper
   4. Preparation of Bottle opener
   5. Preparation of dove-tail joint
   6. Preparation of small size Try-square
   7. Preparation of Coat hook
   8. Preparation of funnel (sheet)
   9. Preparation Pin tray (sheet)
   10. Preparation of Drawer handle
   11. Preparation of bevel square
   12. Preparation of spanner (small size)

3) Welding
   (OXY ACETYLENE)
   1. Flame making gas welding
      (a) Harsh Flame (b) Carburizing Flame (c) Neutral Flame (d) oxidizing
   2. Pool making
   3. Bead making
   4. Edge joint
   5. Open square butt joint (MS Flat 3mm thick)
   6. Open square butt joint (MS Flat 5mm thick)
   7. Half ‘V’ butt joint (Flat Position)
8. ‘V’ Grove butt joint (Flat Position)
9. Corner joint
10. Open square brazing butt joint (MS Flat 3mm thick)

(ARC WELDING)
11. Types of Arc welding machines and their operation with current adjustment
12. Arc making
13. Bead making
14. Open square Butt joint (MS Flat 5mm thick)
15. ‘V’ Grove Butt joint
16. Lap joint
17. Corner Joint (Flat Position)
18. Corner joint (Vertical Position)

4) Basic Machine Shop
1. Practice of cleaning and oiling the lathe machine
2. Practice of centering the job by tool method
3. Practice of centering the job held in a four jaw chuck or face plate
4. Practice of facing
5. Practice of straight turning
6. Practice of center drilling
7. Practice of drilling on lathe
8. Practice of step turning
9. Practice of knurling
10. Practice of boring a straight hole
11. Practice of step or counter boring
12. Practice of reaming
13. Practice of tool grinding
14. Practice of taper turning by compound rest method
15. Practice of cutting metric threads on lathe machine.

5) Electrical Wiring
1 Electrical wiring 10 Hours
1.1 House Wiring
1.1.1 Types and sizes of wiring cables according to voltage, grade, core and strands, insulation.
1.1.2 Wiring accessories and cables current carrying capacity.
1.1.3 Wiring system; cleat, batten, conduit.
1.1.4 Protections of house wiring
   a) Fuses; rewirable, cartridge, H.R.C.  b) Miniature circuit breaker.
   C) Earthing.
1.1.5 Distribution boards.
1.1.6 Testing of wiring.
1.1.7 Electricity rules about domestic wiring and earthing.
1.1.8 Voltage drop in cables and its simple calculation.

1.2 Industrial and Commercial Wiring 5 Hours
1.2.1 Power Wiring System
   1.2.1.1 Steel conduit.
   1.2.1.2 Trunking and Ducting system.
   1.2.1.3 Catenary system.
   1.2.1.4 Tough sheathed cable system.
   1.2.1.5 Special purpose cables; heat resistant, fire retarding welding cables etc.
1.2.2 Three phase power distribution board.
1.2.3 Multistory distribution board.
1.2.4 Cable and fuse size for motors.
1.2.5 Study and use of magnetic contractors, push button, and thermal relay.

2 Safety 5 HOURS

2.1 Fire causes and its prevention, classes of fire.
2.2 Safety in electrical shops safety belt gloves clothing

PRACTICALS
Guidelines for Conduct of Practical’s
Following guidelines are suggested for the teachers before/while conducting or supervising lab/shop activities.

The Teacher Should:

I) Draw project circuit diagram and explain the main concept(s).
II) Demonstrate / identify safety precautions to be taken while conducting practicals.
III) Discuss the procedure for the conduct of exercise by the students.
IV) Identify key points to be specially observed / noted by the students while conducting the experiments.
V) Help students to select tools, equipment, and other material for the practical especially in the context of ratings and sizes.
VI) Guide the students in drawing conclusions / results.
VII) Arrange a general discussion session at the end of practical to summarize the experiment.
VIII) Try to ensure and inculcate safety habits in the students.

List of Practical’s (Electrical Wiring)

1. To study wiring accessories.
2. To study tools used in Wiring.
3. To study types of cables.
4. Demonstration of treatment against electrical shock.
5. To Control one lamp with single way switch.
6. To Control two lamps individually by 1- one way switches.
7. To control three lamps individually by 3 one way switches and installs a fuse.
8. To Control two lamps individually by two -way switch.
9. To Control one lamp from two different places (staircase circuits).
10. To control one lamp from three different places.
11. To control three lamps in series and measure voltage drop across each lamp.
12. To construct a test board.
13. To construct fuse indication circuit.
14. To control two lamps by 2- two-way switches both in parallel and individual control.
15. To control a bell through indicator by push button.
16. To prepare bell indicator circuit (Hotelling Circuit).
17. To prepare goodown circuit.
18. To Study wiring boxes and sealing.
19. To prepare single twist joint.
20. To prepare married joint.
21. To prepare duplex joint.
22. To prepare rat -tail joint.
Instructional Objectives:

1. **Pipe and Pipe Fitting**
   1.1 **Understand Shop Layouts; Rules, Pipe Materials, and Tools**
      1.1.1 Describe the basic concept of the pipe fitting.
      1.1.2 Identify the shop tools.
      1.1.3 Define the safety rules of the shop.
      1.1.4 Give the piping classification.
      1.1.5 Describe the process lines.
      1.1.6 Describe the utility lines.
      1.1.7 State the pipe size.
      1.1.8 State the pipe schedule.
      1.1.9 Name the pipe materials.

   1.2 **Understand Various Methods of Joining the Pipes**
      1.2.1 Understand the methods of joining two or more than two pipes.
      1.2.2 Name the different pipe joints.
      1.2.3 Define process of welded joints.
      1.2.4 Define the process of flanged joints.
      1.2.5 Define the process of screwed joints.
      1.2.6 Explain the process of coupled joints.

   1.3. **Understand Different Procedures of Pipe Fitting**
      1.3.1 Name the types of pipe fitting.
      1.3.2 Explain the pipe supports used in the pipe fitting.
      1.3.3 Describe the process of flared fitting.
      1.3.4 Describe the process of flare less fitting.

   1.4. **Understand Various Types of Tubing**
      1.4.1 Explain the purpose of tubing.
      1.4.2 Enlist various types of tubing.
      1.4.3 Describe metallic tubing.
      1.4.4 Describe seamless tubing.
      1.4.5 Describe welded tubing.

   1.5. **Understand Valves and its types**
      1.5.1 Define Valve
      1.5.2 Describe types of Valve.
      1.5.2.1 Gate Valve
      1.5.2.2 Globe Valve
      1.5.2.3 Ball Valve
      1.5.2.4 Butterfly
      1.5.2.5 Non-Return Valve
      1.5.2.6 Plug Valve
      1.5.2.7 Cage Valve

2. **General Metal Work**
   2.1 **Introduction To Metal Work and Metal Working Tools**
      2.1.1 Observe safety precautions and proper care of Metal working tools and machines
2.2 **Kinds of Tools and Machines**

2.2.1 Understand Metal Working Hand tools
   2.2.1.1 Classify Metal Working Measuring tools
   2.2.1.2 Describe Layout tools and Practice
   2.2.1.3 Describe Cutting tools and Practice
   2.2.1.4 Describe Chisels and Chiseling
   2.2.1.5 Describe Files and Filing
   2.2.1.6 Describe Hacksaws and Hack sawing
   2.2.1.7 Describe Drills, Drilling and Reamers
   2.2.1.8 Describe Taps, Taping and threading dies

2.2.2 Understand Metal Working Machines
   2.2.2.1 Explain Drilling machines
   2.2.2.2 Explain Power Hacksaw
   2.2.2.3 Explain Bending machines
   2.2.2.4 Explain Rolling machine
   2.2.2.5 Explain Shearing machine

2.2.3 Understand Fasteners
   2.2.3.1 Introduction to Fasteners
   2.2.3.2 Explain Types of Screws, Nuts, Bolts, Rivets
   2.2.3.3 Explain Types and applications of related tools

3. **Welding**

3.1 **Familiarized with Welding shop Machinery, Tools and Equipment**
   3.1.1 Define welding
   3.1.2 Describe Welding Processes
     3.1.2.1 Describe Pressure welding
     3.1.2.2 Describe Fusion welding process
   3.1.3 Describe Types of pressure welding process
     3.1.3.1 Describe Forge welding
     3.1.3.2 Describe Resistance welding of Spot welding, Seam welding, Flash welding
   3.1.4 Describe Types of Fusion welding
     3.1.4.1 Describe Oxy acetylene gas welding
     3.1.4.2 Describe Arc welding
     3.1.4.3 Describe Thermo welding
     3.1.4.4 Describe TIG welding
     3.1.4.5 Describe MIG welding
     3.1.4.6 Describe Submerged Arc welding

3.2 **Understand the use of Fusion Welding Tools (Oxy acetylene gas welding, Arc welding)**
   3.2.1 Demonstrate oxy-acetylene gas welding
     3.2.1.1 Describe Tools and equipments
     3.2.1.2 Describe the function and proper uses of oxy-acetylene gas welding
     3.2.1.3 Demonstrate the pressure regulators function, Oxygen Cylinder, acetylene cylinder, injector and non injector type of blow pipe
   3.2.2 Understand the use of Arc welding machines and equipments
     3.2.2.1 Describe the function of step down transformer.
     3.2.2.2 Describe the function of welding tools and their uses
     3.2.2.3 Identification of Arc welding and their uses.
     3.2.2.4 Describe the arc welding processes
   3.2.3 Describe Welding Materials
3.2.3.1 Definition of Flux, its uses and advantages
3.2.3.2 Describe types of filler rod
3.2.3.3 State types of Electrode
3.2.4 Apply the safety method in welding shop
3.2.4.1 Describe the flash back, causes of flash back
3.2.4.2 Explain the back fire, its causes and how to avoid
3.2.4.3 Explain the safety precautions applied during Arc welding, gas welding, forging and grinding
3.2.5 Describe the welding defects like
3.2.5.1 Describe Lack of penetration
3.2.5.2 Describe Slag inclusion
3.2.5.3 Describe Undercut
3.2.5.4 Describe Blow holes

4. Basic Machine Shop
4.1 List the parts of Lathe
4.1.1 Explain the function of each part
4.1.2 Name the “Lathe accessories”
4.1.3 Describe the use of each accessory
4.2 List the materials used for cutting tools
4.2.1 Describe the characteristics of each material
4.2.2 Name the types of cutting tools according to their use.
4.3 Cutting speed and feed
4.3.1 Define cutting speed, feed and depth of cut for lathe work
4.3.2 Describe calculations of cutting speed
4.4 List the lathe operations
4.4.1 Define Centering of work piece on four jaws independent chuck
4.4.2 Describe the importance of centering the work piece
4.4.3 Define facing
4.4.4 Describe the method of facing a work piece held in a chuck
4.4.5 Define straight turning
4.4.6 Describe the method of rough and finish turning
4.4.7 Define step turning
4.4.8 Define shoulder
4.4.9 Describe the types of shoulder
4.4.10 Define knurling
4.4.11 Describe the purpose of knurling
4.4.12 Describe the types of knurling according to shape and grade
4.4.13 Define center drilling
4.4.14 Define drilling
4.4.15 Describe the method of drilling and center drilling on lathe machine
4.4.16 Define taper and taper turning
4.4.17 Describe the compound slide method of taper turning
4.5 List parts of tool grinder
4.5.1 Describe each part
4.6 List parts of shaper
4.6.1 Describe each part
إسلاميات/مطالعة وباكستان
생 (سالوم)
حصة أول إسلاميات 211
ني ي

حصة دوم مطالعة وباكستان

1. ديوان ألمزج

2. خيركم من تعلم القرآن وعلمه

لا إيمان لمن لا أمانة له ولادين لمن عهدته

اياكم والظن أن النمل أذك الحديث

من أحدث في أمرنا هذا ما ليس منه فيهورد

من حمل علينا السلاح فليس لنا

ään وا فق الحكيم في الجنة هكذا

لا يؤمن أحد كم حتى أكون أحب إليه من والده وولده والناس اجمعين

من بين الله مسجد ابني المله له بيئا في الجنة

لا ضر ولا ضرار في الإسلام

كلكم راع وكلكم مسنول عن رعيته

3. كتب التعبير

أين إنك وحملت، فثبتن بعلم.

مذي نذك وTimeZone، مختل مديد، كم (سابق دانان)

4. طور خضراء:

مطامعك بالسراج غادان

5. عطار جابر

ابن عمرو، وابن عفان، وابن عفان، وابن عفان، وابن عفان

6. إسلاميات

استمتع كأنت قريع إسلاميات إسلاميات إسلاميات إسلاميات إسلاميات...
عمالات

تدریجی مقایسه

قرآن میں عورت کے گروہ کا تجربہ کیا گیا تھا کہ کسی ایک آیت قرآنی کی روشنی میں قرار کے ایک اور الفاظ کی۔

خصوصی مقایسه

- قرآنی آیات کڑھ منہ پر کے
- قرآنی آیات کے انتہائی مقبول کے
- قرآنی آیات کے غیر منہ کے ایک عورت کا
- قرآنی آیات کے منہ پر کے

اہمیت بہت بڑی ہے

عمور مقصر احادیث کی روشنی میں اسلام کی اخلاقی آداب (افراڈ و جنتا) کی تعلیمات کے

خصخصی مقایسه

- احادیث کی کڑھ منہ پر کے
- احادیث کی انتہائی مقبول کے
- احادیث کی غیر منہ کے اخلاقی آداب کی تعلیمات کے

ہم احادیث میں کبھی کبھی تعلیمات کے مطلب اپنی طرف سے اور کسی

کسی طرح

عمور مقصر رواج عورت کی بجرہ نظر ہے عامان کے

خصخصی مقایسه

- رواج عورت کی بجرہ نظر کے مطلب بھی ہے
- رواج عورت کی بجرہ نظر کے
- رواج عورت کی بجرہ نظر کے
- رواج عورت کی بجرہ نظر کے

کسی طرح
اسلامی معاشرہ

ویکی متعلقہ اسلامی معاشرہ کی تحریمیات سے اگاہ کیہ

خصوصی مقاصد

- اسلامی معاشرہ کے پسندیدہ مبناں کے
- اسلامی معاشرہ کی امانی کی تحریمیات سے بانان کرے
- اسلامی معاشرہ کی امانی کی تحریمیات سے بانان کرے
- اسلامی معاشرہ کی امانی کی تحریمیات سے بانان کرے
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اسلامی ریاست

- اسلامی ریاست کی تحریمیات سے بانان کرے

خصوصی مقاصد

- اسلامی ریاست کی تحریمیات سے بانان کرے
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- اسلامی ریاست کی تحریمیات سے بانان کرے

67
نصاب اخلاقیات (بخش‌های کلیت)

91

سال 1001

موارد:

-aversal بی‌فضایی
- قوت بی‌دریافت
- قوت دردشته
- قوت مادی
- قوت ذره‌ور
- ویژه‌ترین
- آدمی
- انسان
- شخصی
- پرسار
- پاس‌آور
- کلیت
- کلیت‌گذار
- تغییر
- خورشیدی
نسب اخلاقیات

سال 1972

ندیبی مستعمر

عمی متعاصد
طلاب علم

اضافی کی ابتہجت و ضرورت ہے اگر ہمارے کے اور بینان کے

نگر کی متعاصد طالب علم سے متعلق ہے۔

مواد کا مطلب بیان کیے جاکر

عمیکری جنگ کے سمت کا کافی ترکیب کے

اثر کے نشانات اور معاشرے کے مطالعہ تاریخ کی اثرات بہت کر کے اور بینان کے

اثری اخلاقی اقدامات کے

ہوتے ہیں اور دیکھے جانے ہمہ دیکھیں ہمہ

کامل اکائی اور پناہ گا کی ابتہجت بیان کے

اضافی کی متعلق بیانوں کی ضرورت پر ایجاد کے

کے
Math 223  

Pre-requisite: Mathematics I.

AIMS 

1. Solve problems of Calculus and Analytic Geometry.
2. Develop mathematical skill, attitudes and logical perception in the use of mathematical instruments.
3. Apply principles of Differential Calculus to work out rate measures, velocity, acceleration, maxima & minima values.
4. Use principles of Integral Calculus to compute areas & volumes.
5. Acquire proficiency in solving technological problems with mathematical clarity and insight.

COURSE CONTENTS

1. FUNCTIONS & LIMITS. 6 Hours
   1.1 Constant & Variable Quantities
   1.2 Functions & their classification
   1.3 The concept of Limit
   1.4 Limit of a Function
   1.5 Fundamental Theorems on Limit
   1.6 Some important Limits
   1.7 Problems

2. DIFFERENTIATION 6 Hours
   2.1 Increments
   2.2 Differential Coefficient or Derivative
   2.3 Differentiation ab-initio or by first Principle
   2.4 Geometrical Interpretation of Differential Coefficient
   2.5 Differential Coefficient of $x^n$, $(ax + b)^n$
   2.6 Three important rules
   2.7 Problems

3. DIFFERENTIATION OF ALGEBRAIC FUNCTIONS 9 Hours
   3.1 Explicit Functions
   3.2 Implicit Functions
   3.3 Parametric forms
   3.4 Problems

4. DIFFERENTIATION OF TRIGONOMETRIC FUNCTIONS 6 Hours
   4.1 Differential Coefficient of Sin x, Cos x, Tan x from first principle.
4.2 Differential Coefficient of Cosec x, Sec x, Cot x.
4.3 Differentiation of inverse Trigonometric functions.
4.4 Problems.

5. DIFFERENTIATIONS OF LOGARITHMIC & EXPONENTIAL FUNCTIONS 6 Hours

5.1 Differentiation of ln x
5.2 Differentiation of Log \( a^x \)
5.3 Differentiation of \( a^x \)
5.4 Differentiation of \( e^x \)
5.5 Problems

6. RATE OF CHANGE OF VARIABLES. 6 Hours

6.1 Increasing and decreasing functions
6.2 Maxima and Minima values
6.3 Criteria for maximum & minimum values
6.4 Methods of finding maxima & minima
6.5 Problems

7. INTEGRATION 9 Hours

7.1 Concept
7.2 Fundamental Formulas
7.3 Important Rules
7.4 Problems

8. METHODS OF INTEGRATION 9 Hours

8.1 Integration by substitution
8.2 Integration by parts
8.3 Problems

9. DEFINITE INTEGRALS 6 Hours

9.1 Properties
9.2 Application to area
9.3 Problems

10. DIFFERENTIAL EQUATIONS 6 Hours

10.1 Introduction
10.2 Degree and Order
10.3 First order differential equation
10.4 Solution
10.5 Problems

11. PLANE ANALYTIC GEOMETRY & STRAIGHT LINE 6 Hours

11.1 Coordinate System
11.2 Distance Formula
11.3 The Ratio Formula
11.4 Inclination and slope of a line
11.5 The slope Formula
11.6 Problems

12. EQUATIONS OF STRAIGHT LINE 6 Hours

12.1 Some important Forms
12.2 General Form
12.3 Angle Formula
12.4 Parallelism & Perpendicularity
12.5 Problems

13. **EQUATIONS OF CIRCLE**  
13.1 Standard form of Equation  
13.2 Central form of Equation  
13.3 General form of Equation  
13.4 Radius & Coordinates of the centre  
13.5 Problems  
6 Hours

14. **STATISTICS**  
14.1 Concept of mean, median and mode  
14.2 Standard deviation  
14.3 Laws of probability  
14.4 Problems  
9 Hours

**REFERENCE BOOKS**

1. Thomas Finny- Calculus and Analytic Geometry
Math-223      APPLIED MATHEMATICS

INSTRUCTIONAL OBJECTIVES

1. USE THE CONCEPT OF FUNCTIONS AND THEIR LIMITS IN SOLVING SIMPLE PROBLEMS.
   1.1 Define a function.
   1.2 List all type of functions.
   1.3 Explain the concept of limit and limit of a function.
   1.4 Explain fundamental theorems on limits.
   1.5 Derive some important limits.
   1.6 solve problems on limits.

2. UNDERSTAND THE CONCEPT OF DIFFERENTIAL COEFFICIENT
   2.1 Derive mathematical expression for a differential coefficient.
   2.2 Explain geometrical interpretation of differential coefficient.
   2.3 Differentiate a constant, a constant associated with a variable and the sum of finite number of functions.
   2.4 Solve related problems.

3. USE RULES OF DIFFERENTIATION TO SOLVE PROBLEMS OF ALGEBRAIC FUNCTIONS.
   3.1 Differentiate ab-initio $x^n$ and $(ax+b)^n$.
   3.2 Derive product, quotient and chain rules.
   3.3 Find derivatives of implicit functions and explicit functions.
   3.4 Differentiate parametric forms, functions w.r.t another function and by rationalization.
   3.5 Solve problems using these formulas.

4. USE RULES OF DIFFERENTIATION TO SOLVE PROBLEMS INVOLVING TRIGONOMETRIC FUNCTIONS.
   4.1 Differentiate from first principle sin x, Cos x, tan x.
   4.2 Derive formula Derivatives of Sec x, Cosec x, Cot x.
   4.3 Find differential coefficients of inverse trigonometric functions
   4.4 Solve problems based on these formulas.

5. USE RULES OF DIFFERENTIATION TO LOGARITHMIC AND EXPONENTIAL FUNCTIONS.
   5.1 Derive formulas for differential coefficient of Logarithmic and exponential functions.
   5.2 Solve problems using these formulas.

6. UNDERSTAND RATE OF CHANGE OF ONE VARIABLE WITH RESPECT TO ANOTHER.
   6.1 Derive formula for velocity, acceleration and slope of a line.
   6.2 Define an increasing and a decreasing function, maxima and minima values, point of inflexion.
   6.3 Explain criteria for maxima and minima values of a function.
   6.4 Solve problems involving rate of change of variables.
7. **USE RULES OF INTEGRATION IN SOLVING RELEVANT PROBLEMS.**
   7.1 Explain the concept of integration.
   7.2 State basic theorems of integration.
   7.3 List some important rules of integration.
   7.4 Derive fundamental formulas of integration.
   7.5 Solve problems of integration based on these rules/formulas.

8. **UNDERSTAND DIFFERENT METHODS OF INTEGRATION**
   8.1 List standard formulas of Integration.
   8.2 Integrate a function by substitution method.
   8.3 Find integrals by the method of integration by parts.
   8.4 Solve problems using these methods.

9. **UNDERSTAND METHODS OF SOLVING DEFINITE INTEGRALS.**
   9.1 Define definite integral.
   9.2 List properties of definite integrals.
   9.3 Find areas under the curves using definite integrals.
   9.4 Solve problems of definite integrals.

10. **USE DIFFERENT METHODS OF INTEGRATION TO SOLVE DIFFERENTIAL EQUATIONS**
    10.1 Define a differential equation, its degree and order
    10.2 Explain method of separation of variables to solve differential equation of first order and first degree.
    10.3 Solve differential equations of first order and first degree

11. **UNDERSTAND THE CONCEPT OF PLANE ANALYTIC GEOMETRY.**
    11.1 Explain the rectangular coordinate system.
    11.2 Locate points in different quadrants.
    11.3 Derive distance formula.
    11.4 Prove section formulas.
    11.5 Derive Slope Formula
    11.6 Solve problem using these formulas.

12. **USE EQUATIONS OF STRAIGHT LINE IN SOLVING PROBLEMS.**
    12.1 Define a straight line.
    12.2 Write general form of equation of a straight line.
    12.3 Derive slope intercept and intercept forms of equations of a straight line.
    12.4 Derive expression for angle between two straight lines.
    12.5 Derive conditions of perpendicularity and parallelism of two straight lines.
    12.6 Solve problems involving these equations/formulas.

13. **SOLVE TECHNOLOGICAL PROBLEMS USING EQUATIONS OF CIRCLE.**
    13.1 Define a circle.
    13.2 Describe standard, central and general forms of the equation of a circle.
    13.3 Convert general form to the central form of equation of a circle.
    13.4 Derive formula for the radius and the coordinates of the center of a circle from the general form.
    13.5 Derive equation of the circle passing through three given points.
    13.6 Solve problems involving these equations.
14. UNDERSTAND THE BASIC CONCEPT OF STATISTICS.
14.1 Define mean, median and mode
14.2 Explain standard deviation
14.3 State laws of probability
14.4 Calculate the above mentioned quantities using the proper formula.
Mgm- 211 BUSINESS COMMUNICATIONS

Total contact hours
Theory 32 Hrs.

Prerequisites: The students shall already be familiar with the language concerned.

AIMS  The course has been designed to enable the students to.
1. Develop communication skills.
2. Understand basic principles of good and effective business writing in commercial and industrial fields.
3. Develop knowledge and skill to write technical report with confidence and accuracy.

COURSE CONTENTS

1. COMMUNICATION PROCESS.  6 Hours
   1.1 Purposes of communication
   1.2 Communication process
   1.3 Distortions in communication
   1.4 Consolidation of communique
   1.5 Communication flow
   1.6 Communication for self development

2. ORAL COMMUNICATION SKILLS.  6 Hours
   2.1 Significance of speaking.
   2.2 Verbal and non-verbal messages.
   2.3 Strategic steps of speaking.
   2.4 Characteristics of effective oral messages.
   2.5 Communication Trafficking.
   2.6 Oral presentation.

3. QUESTIONING SKILLS.  3 Hours
   3.1 Nature of question.
   3.2 Types of questions.
   3.3 Characteristics of a good question.
   3.4 Questioning strategy

4. LISTENING SKILLS.  5 Hours
   4.1 Principles of active listening.
   4.2 Skills of active listening.
   4.3 Barriers to listening.
   4.4 Reasons of poor listening.
   4.5 Giving Feedback.

5. INTERVIEWING SKILLS.  3 Hours
   5.1 Significance of interviews.
5.2 Characteristics of interviews.
5.3 Activities in an interviewing situation
5.4 Types of interviews.
5.5 Interviewing strategy.

6. REPORT WRITING. 3 Hours
6.1 Goals of report writing
6.2 Report format.
6.3 Types of reports.
6.4 Report writing strategy.

7. READING COMPREHENSION. 2 Hours
7.1 Reading problems.
7.2 Four Reading skills.

8. GROUP COMMUNICATION. 4 Hours
8.1 Purposes of conducting meetings.
8.2 Planning a meeting.
8.3 Types of meetings.
8.4 Selection f a group for meeting.
8.5 Group leadership skills.
8.6 Running a successful meeting.
8.7 Active participation techniques.

RECOMMENDED BOOKS
Mgm-211 BUSINESS COMMUNICATIONS.

INSTRUCTIONAL OBJECTIVES

1. UNDERSTAND THE COMMUNICATION PROCESS.
   1.1 State the benefits of two way communication.
   1.2 Describe a model of communication process.
   1.3 Explain the major communication methods used in organization.
   1.4 Identify the barriers to communication and methods of overcoming these barriers.
   1.5 Identify misconceptions about communication.

2. UNDERSTAND THE PROCESS OF ORAL.
   2.1 Identify speaking situations with other peoples.
   2.2 Identify the strategy steps of speaking.
   2.3 Identify the characteristics of effective speaking.
   2.4 State the principles of one-way communication.
   2.5 State the principles of two-way communication.
   2.6 Identify the elements of oral presentation skills.
   2.7 Determine the impact of non-verbal communication on oral communication.

3. DETERMINE THE USES OF QUESTIONING SKILLS TO GATHER AND CLARIFY INFORMATION IN THE ORAL COMMUNICATION PROCESS.
   3.1 Identify different types of questions.
   3.2 Determine the purpose of each type of question and its application.
   3.3 Identify the hazards to be avoided when asking questions.
   3.4 Demonstrate questioning skills.

4. DEMONSTRATE THE USE OF ACTIVE LISTENING SKILL IN THE ORAL COMMUNICATION PROCESS.
   4.1 State the principles of active listening.
   4.2 Identify skills of active listening.
   4.3 Identify barriers to active listening.
   4.4 State the benefits of active listening.
   4.5 Demonstrate listening skills.
   4.6 Explain the importance of giving and receiving feed back.

5. Determine the appropriate interview type for the specific work-related situation and conduct a work-related interview.
   5.1 State the significance of interviews.
   5.2 State the characteristics of interviews.
   5.3 Explain the activities in an interviewing situation.
   5.4 Describe the types of interviews.
   5.5 Explain the interviewing strategy.
   5.6 Prepare instrument for a structured interview.

6. PREPARE A REPORT OUT-LINE, BASED ON SUBJECT MATTER AND AUDIENCE.
   6.1 Identify the different types of reports.
   6.2 Determine when to use an informal or formal report presentation.
6.3 Identify the stages of planning a report.
6.4 Identify the parts of a report and choose the parts appropriate for each type of report.
6.5 Draft a report outline.

7. DEMONSTRATE READING COMPREHENSION.
   7.1 Identify major reading problems.
   7.2 Identify basic reading skills.
   7.3 State methods of previewing written material.
   7.4 Identify methods of concentration when reading.
   7.5 Demonstrate reading comprehension.

8. UNDERSTAND THE PRINCIPLES OF GROUP COMMUNICATIONS.
   8.1 State the purpose and characteristics of major types of meeting.
   8.2 Explain responsibilities of a meeting/committee.
   8.3 Identify problems likely to be faced at meeting and means to overcome these problems.
   8.4 Distinguish between content and process at meetings.
   8.5 Explain the key characteristics of a good group facilitator.
APPLIED ELECTRICITY AND ELECTRONICS

CODE: ET-212T        P          C        1       3       2

TOTAL CONTACT HOURS:

Theory  32  
Practical  96

AIMS:
This course enables the students to understand the fundamentals of electricity, know the devices used for control of industrial equipments, their properties and uses. The course provides the knowledge of working principles and operation of A. C. and D. C. motors, transformers, and generators, interpret connection diagrams of various electrical devices, Students will be able to observe safety rules and provide electric shock treatment.

COURSE CONTENTS

1. Fundamentals of Electricity.  3 Hours
   1.1 Current, Voltage, Resistance, their units
   1.2 Ohms law, simple calculations.
   1.3 Laws of resistances, simple calculations.
   1.4 Combination of resistances, simple calculations.
   1.5 Electrical and mechanical power, their conversion, units, horsepower.
   1.6 Heating effect of current, Joules law.
   1.7 Electrical energy, units, energy bill.
   1.8 Thermal relay.

2. Fundamentals of Electro-Magnetism  5 Hours
   2.1 Magnetism, units, theory of magnetism.
   2.2 Permeability, Ferromagnetic materials.
   2.3 Electromagnetism fields around current-carrying conductors, coils, and Fleming right hand rule.
   2.4 Force on current carrying conductor lying in magnetic field left hand rule.
   2.5 Faraday laws of electromagnetic induction, basic AC generator.
   2.6 Self and mutual induction, elementary transformer.
   2.7 Magnetic relays and connectors.

3. Motors, Generators, and Transformers  5 Hours
   3.1 Construction and working of AC and DC generators.
   3.2 Construction and working of transformers, emf and current equation types.
   3.3 Welding transformers, ratings.
   3.4 Types and working of -AC- motors; 1-Phase Induction Motor, 3-Phase Induction motors.
   3.5 Principle of induction heating, construction, ratings of induction furnaces.

4. Batteries and Cells
   4.1 Types of cells; Primary, Secondary.
   4.2 Types of secondary cells, Voltage ratings.
   4.3 Charging and discharging of lead acid battery.
   4.4 Precautions in handling batteries.
   4.5 Alkaline batteries, ratings.
5 Fundamentals of Electronics 4 Hours
  5.1 Semiconductor theory, doping, P & N type materials.
  5.2 PN Junction diode, potential barrier, forward and reverse bias.
  5.3 Use of PN diode as rectifiers.
  5.4 Filtering.

6. Transistors 5 Hours
  6.1 PNP &NPN transistors,-biasing, working.
  6.2 Use of transistors as amplifiers, gains in CE, CB and CC amplifiers.
  6.3 Field effect transistors, construction and uses.
  6.4 Transistors as oscillators.

7 Special Purpose Diodes and Devices 5 Hours
  7.1 Zener diodes, uses, ratings.
  7.2 Photodiodes uses.
  7.3 DIAC, uses.
  7.4 TRIAC, uses.
  7.5 Saturable core reactor.

8. Thyristors 3 Hours
  8.1 UJT, working, uses as oscillators.
  8.2 SCR, working, uses as control devices.
  8.3 Phase control of SCR

BOOKS RECOMMENDED
1. Examples of Electrical Calculations, by Admiralty.
2. Reed Basic Electro-Technology for Marine Engineers, KRAAL.
3. Electrical Technology, B. L. Theraja.
5. Basic Electronics, B. Grob.
PRACTICALS

96 Hours

1. Study of electrical measuring instruments, handling precautions, methods of connection.
2. Verification of Ohm law.
3. Verification of laws of combination of resistances.
5. Measurement of energy.
6. Study of thermal and magnetic relays/contractors.
7. Study of magnetic fields due to current carrying conductors, coils.
8. Verification of Faraday’s laws of electromagnetic induction.
10. Study of magnetic relays.
12. Study of transformers, determination of voltage ratio.
13. Study of welding transformers.
15. Starting three phase induction motors, reversal.
16. Connections of magnetic starters with motors.
17. Connections of 3-point (forward-stop-reverse) starters.
18. Study of induction furnaces, their controls.
20. Charging of lead-acid batteries, safety precautions, preparation of electrolyte.
21. Study and connections of PN diodes as rectifiers.
22. Connecting PN diode as half-wave and full-wave.
23. Connecting PN diode- as bridge rectifiers with filter.
24. Study connections and biasing of PNP and NPN transistors.
25. Determination of current and voltage gains of CE amplifier.
26. Study and connections of Zener diode as voltage regulator.
27. Study and connections of photodiode as light sensing device.
28. Study and connections of DIAC and TRIAC as switch circuits.
29. Determination of intrinsic stand-off ratio of UJT.
30. A Connections of UJT as relaxation oscillator.
31. Study and connections of SCR as a power switch.
32. Study of phase control of SCR.
1. **Understand Basic Concepts and Laws of Electricity.**
   1.1 Define units of Current, Voltage, and Resistance.
   1.2 Explain Ohms law.
   1.3 Solve simple problems on Ohm Law.
   1.4 Substitute two of the three variables to find the third unknown in equation $V = IR$.
   1.5 Calculate the equivalent resistances for resistors joined in series.
   1.6 Calculate electrical and mechanical power and the interrelation between the two systems.
   1.7 Calculate the electrical energy consumption in an installation and prepare the energy bill.
   1.8 State the action of different types of thermal relay's.

2. **Understand the Fundamental Concept of Electro-Magnetism**
   2.1 State molecular theory of magnetism.
   2.2 Define various units involving magnetism.
   2.3 State the magnetic properties of materials and permeability.
   2.4 State the magnetism associated with current carrying conductors and coils.
   2.5 State Fleming’s right hand rule.
   2.6 Explain the force experienced by the current carrying conductors in magnetic fields according to Fleming’s right hand rule.
   2.7 State Faraday’s laws of electromagnetic induction.
   2.8 Explain the production of A.C. in a simple coil rotating in a uniform magnetized.
   2.9 State the self induction in a coil and the mutually induced voltage in a nearby coil due to fuse linkage.
   2.10 Explain the working of magnetic relays and contractors.

3. **Understand Working of Electric Motors, Generators, and Transformers**
   3.1 State the main parts of D.C. electric motors and D.C. generators.
   3.2 State the construction of alienator.
   3.3 State the construction of three phase and single phase induction motors.
   3.4 Explain the working principle of transformers.
   3.5 State various parts of a transformer.
   3.6 State the emf equation of transformer and transformation ratio equation.
   3.7 Explain the working of transformer specially designed for welding purpose and its settings.
   3.8 Explain the working of different types of electric furnaces.
   3.9 Explain the working of electric spot welding machine.

4. **Understand the Electrochemical Effect and its Application in Various Types of Batteries and Cells**
   4.1 Define the primary and secondary cells.
   4.2 State different types of secondary cells and their voltage ratings.
   4.3 Explain the method of charging of a lead acid battery.
   4.4 Enlist the precautions in handling batteries.
   4.5 State the construction of alkaline batteries and their ratings.

5. **Understand the Fundamentals of Electronics**
   5.1 State the semiconductor theory.
   5.2 State how P-type and N-type material is produced.
5.3 State the action of potential barrier in a PN junction and the effect of forward and reverse bias on the junction.
5.4 Draw the circuit diagram for half wave and full wave rectifier.
5.5 Draw the bridge rectifier circuit with filter circuit.

6. **Transistors.**
6.1 State the biasing working of PNP & NPN type of transistor.
6.2 Draw the circuit indicating the method of biasing the NPN and PNP transistors.
6.3 Draw the different types of amplifier connections (C.B., C.B., and C.C.)
6.4 State the working of field effect transistors.
6.5 Enlist the comparative properties and usage of two types of transistors (Bipolar versus F.E.T.)
6.6 State the working of a transistor oscillator and draw its circuit diagram.

7. **Understand the Working of Special Purpose Devices**
7.1 State the working of zener diode.
7.2 Draw the connection for a practical regulated power supply.
7.3 State the working of photodiode and its uses.
7.4 State the working of DIAC and its uses.
7.5 State the working of TRIAC and its uses.
7.6 State the working of saturable core reactor and its use.

8. **Understand the Application of Thyristors in Control Circuits.**
8.1 Explain the working of Unijunction Transistor and its use as an oscillator.
8.2 Draw circuit of a UJT relaxation oscillator.
8.3 Explain the working of silicon controlled rectifier and its uses as a controlling device.
8.4 Explain the phase control with the help of S.C.R. for A.C Loads.
8.5 Draw circuits using phase control by SCR
PCT-203 FLUID MECHANICS AND THERMODYNAMICS

Total Contact Hours

<table>
<thead>
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<th>Theory: 64 Hrs</th>
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<tr>
<td>Practical: 96 Hrs</td>
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Pre-requisites: None

AIMS: This course is designed to assist the students:
1. To gain basic knowledge of fluid mechanics and its application in fluids flow problems of practical interest.
2. To understand the types and operating principles of pumps and compressors.
3. To understand the fundamental knowledge of thermodynamics and heat transfer and its application to problems of practical interest.

Detail Course Contents:

Part-I: FLUID MECHANICS.
1. Classification of Fluids and Flow Regimes 12 Hours
   1.1 Identify and state various branches of fluids mechanics.
   1.2 Distinguish between a solid and fluids.
   1.3 Distinguish between a gas and liquid.
   1.4 State interrelationship of Fluid Mechanics and Thermodynamics.
   1.5 Enlist important properties of fluids.
   1.6 Define and discuss each of the above noted fluid properties.
   1.7 Define pressure and give its types.
   1.8 Distinguish between Newtonian and Non-Newtonian Fluids and give examples of each type.
   1.9 Outline classification of Non-Newtonian fluids.
   1.10 Explain Continuity Equation.
   1.11 Explain the equation which expresses pressure in terms of height of fluids.
   1.12 Explain Bernoulli’s Equation.
   1.13 Discuss pipe flow of Newtonian liquids and describe velocity profiles in case of laminar and turbulent.
   1.14 Explain Reynolds criterion for laminar and turbulent flow regime.

2. PUMPS 10 Hours
   2.1 State the functions of pumps.
   2.2 State the classification of pumps.
   2.3 Explain the operating principles of centrifugal pumps.
   2.4 Identify and name the main parts of centrifugal pumps.
   2.5 State the functions of multistage centrifugal pumps.
   2.6 State the difference between series and parallel pump connections.
   2.7 State the classification and explain the operating principles of positive displacement pumps.
   2.8 Describe the types of reciprocating pumps.
   2.9 Give comparison of centrifugal and reciprocating pump.
   2.10 Describe cavitations in pumps, its causes and remedy.
   2.9 Explain the principle of Rotary pump and describe the working of types of Rotary pumps.
   2.10 Explain construction and working of Diaphragm pump.
2.11 Describe the Trouble-Shooting in Pumps, their causes and remedy.

3. **COMPRESSORS**
   8 Hours
   3.1 State the functions of compressors.
   3.2 State the classification of compressor.
   3.3 Explain the operating principle and types of Volumetric Displacement compressors.
   3.4 Explain the operating principle of reciprocating compressor.
   3.5 State types of reciprocating compressors.
   3.6 Explain the methods of Controlling Reciprocating Compressor Output.
   3.7 Describe the Reciprocating Compressor Starting and Operating Procedures.
   3.8 State the operating principle of Centrifugal Compressor.
   3.9 Identify and state the names of types of Rotary compressors.
   3.10 Explain the Reciprocating and Centrifugal Compressor operating problems, their causes and remedial action.
   3.11 Compressor for CNG Filling Station.

Part-II: **THERMODYNAMICS**

4. **Introduction to Thermodynamics**
   8 Hours
   4.1 Thermodynamics.
   4.2 Dimensions and units.
   4.3 Thermodynamic Pressure.
   4.4 Thermodynamic Systems.
   4.5 Thermodynamic Properties.
   4.6 Thermodynamic Equilibrium and Equilibrium States.
   4.7 Temperature and the Zeroth Law of Thermodynamics.
   4.8 Thermodynamic Processes.

5. **Laws of Thermodynamics**
   6 Hours
   5.1 First law of Thermodynamics.
   5.2 Definition.
   5.3 Derive Equation.
   5.4 Second law of Thermodynamics.
   5.5 Definition.
   5.6 Entropy.

6. **Understand Basics of Heat Transfer**
   14 Hours
   6.1 Define heat transfer and state modes of heat transfer.
   6.2 Define and explain heat transfer by Conduction.
   6.3 Define Fourier’s Law of heat conduction and give its mathematical expression.
   6.4 Define and explain heat transfer by Convection.
   6.5 Define and explain heat transfer by Radiation.
   6.6 Describe Convective heat transfer with change of phase.
   6.7 Describe Boiling and Condensation heat transfer.
   6.8 Describe overall heat transfer.
   6.9 State various factors that affect the heat transfer.
   6.10 Define and give purposes of Insulations.
   6.11 Give classification of Thermal Insulators.
   6.12 Describe cryogenic and multilayer insulation.

7. **Understand Heat Exchangers, Heaters and Boilers**
   6 Hours
   7.1 Define a Heat Exchanger.
   7.2 Sketch a simple diagram to illustrate the basic function of a heat exchanger.
   7.3 Give classification of Heat Exchangers.
   7.4 Draw a single pass shell and tube type heat exchanger to show ten parts of Construction.
7.5 Describe Double Pipe Heat Exchanger.
7.6 Explain extended area air cooled heat exchangers.
7.7 Draw a diagram of a forced draught air cooler and describe its operation.
7.8 Explain the fundamental difference between direct and indirect fired heaters.
7.9 List three operational applications of indirect heaters at gas Production Facilities.
7.10 Describe the function of the fire tube in an indirect fired heater.
7.11 Draw the diagrams to show the basic construction of the
   i) Condensate Heater Reactor   ii) Condensate Stabilizer Reboiler
   iii) Glycol Reboiler.

**Recommended Textbooks:**

7. Union Texas Pakistan Inc., Technician Assistant, Elementary and Intermediate Craft & Skills, Part II.
8. Union Texas Pakistan Inc., Production Operator, Part I & II.
List of Practical:

1. Introduction to the fluids mechanics and thermodynamics laboratory.
2. Observe hydraulic bench and its function.
3. Study the construction and parts of a centrifugal pump by dismantling and assembling.
4. Study the operating characteristics and performance of a centrifugal type pump.
5. Study the construction and parts of a reciprocating pump by dismantling and assembling.
6. Study the operating characteristics and performance of a reciprocating type pump.
7. Study the construction and parts of a rotary pump by dismantling and assembling.
8. Study the operating characteristics and performance of a rotary type pump.
9. Calibrate a storage tank to obtain weight and volume relationship per unit height.
10. Prepare a graph of coefficient of discharge of an orifice versus Reynolds Number.
11. Study the construction and parts of a centrifugal Compressor by dismantling and assembling.
12. Study the construction and parts of a reciprocating Compressor by dismantling and assembling.
13. Study the construction and parts of a rotary Compressor by dismantling and assembling.
14. To determine the speed of air by means of a pitot tube.
15. To determine the velocity profile of water, flowing at a low rate (laminar flow) through glass tube by means of inserting a slug of colored indicator.
16. To study the construction and parts of a heat exchanger.
17. To determine heat transfer rate in a shell and tube heat exchanger.
18. To study the performance of simple tube condenser of a distillation apparatus.
19. To determine the speed of a motor shaft in rpm by Tachometer.
20. Practice of Measurement of pressure at various connections in hydraulic circuits.
21. To study the flow of water over Weirs and Notches.
PCT-203 Instructional Objectives:

1. Part-I: FLUID MECHANICS
   1. Understand classification of Fluids and Flow Regimes
      1.1 Identify and state various branches of fluids mechanics; Fluid Statics, Fluid Kinematics, Hydrodynamics, Hydraulics, Fluid Mechanics.
      1.2 Distinguish between a solid and fluids.
      1.3 Distinguish between a gas and liquid.
      1.4 State interrelationship of Fluid Mechanics and Thermodynamics.
      1.5 Enlist important properties of fluids; Density, Specific Weight, Specific Volume, Specific Gravity, Compressibility of Liquids, Compressibility of Gases, Viscosity, Vapor pressure of Liquids.
      1.6 Define and discuss each of the above noted fluid properties.
      1.7 Define Pressure and state types of pressures.
         1.7.1 Define Gauge Pressure.
         1.7.2 Define Atmospheric Pressure.
         1.7.3 Define Vacuum or Vacuum Pressure.
         1.7.4 Define Absolute Pressure.
         1.7.5 Describe relationship between these types of Pressures.
      1.8 Distinguish between Newtonian and Non-Newtonian Fluids and give examples of each type.
      1.9 Outline classification of Non-Newtonian fluids.
      1.10 Explain Continuity Equation.
      1.11 Explain the equation which expresses pressure in terms of height of fluids. Solve relevant numerical problems.
      1.12 Explain Bernoulli’s Equation.
         1.12.1 Describe applications of Bernoulli’s Equation.
         1.12.2 Describe limitations of Bernoulli’s Equation.
      1.13 Discuss pipe flow of Newtonian liquids and describe velocity profiles in case of laminar and turbulent.
      1.14 Explain Reynolds criterion for laminar and turbulent flow regime. Solve relevant numerical problems.

2. PUMPS
   2.1 State the functions of pumps.
   2.2 State the classification of pumps.
   2.3 Explain the operating principles of centrifugal pumps.
   2.4 Identify and name the main parts of centrifugal pumps.
      2.4.1 Identify the names of common types of impellers and their function.
      2.4.2 Explain the functions of each part of a centrifugal pump.
      2.4.3 Describe the types of Impeller suction.
   2.5 State the functions of multistage centrifugal pumps.
   2.6 State the difference between series and parallel pump connections.
   2.7 State the classification and explain the operating principles of positive displacement pumps.
   2.8 Describe the types of reciprocating pumps.
      2.8.1 Identify and name the main parts of reciprocating pumps.
      2.8.2 Explain the functions of each part of a reciprocating pump.
      2.8.3 Explain working of single acting and double acting Piston and Plunger
reciprocating pumps.

2.9 Give comparison of centrifugal and reciprocating pump.
2.10 Describe cavitations in pumps, its causes and remedy.
2.9 Explain the principle of Rotary pump and describe the working of following types of 2.9 Rotary pumps.
2.9.1 Lobe pump.
2.9.2 Vane pump.
2.9.3 Flexible Impeller pump.
2.9.4 Gear pump.
2.10 Explain construction and working of Diaphragm pump.
2.11 Describe the Trouble-Shooting in Pumps, their causes and remedy.

3. **COMPRESSORS**
3.1 State the functions of compressors.
3.2 State the classification of compressor.
3.3 Explain the operating principle and types of Volumetric Displacement compressors.
3.4 Explain the operating principle of reciprocating compressor.
3.4.1 Describe the working Cycle of reciprocating compressor.
3.4.2 State the names of the basic parts of reciprocating compressor.
3.4.3 State function of each part of reciprocating compressor.
3.5 State types of reciprocating compressors.
3.5.1 Explain Single Acting and Double Acting reciprocating compressors.
3.5.2 Describe Single Sage and Multistage reciprocating compressors.
3.5.3 Describe Duplex Compressor.
3.6 Explain the methods of Controlling Reciprocating Compressor Output.
3.7 Describe the Reciprocating Compressor Starting and Operating Procedures.
3.8 State the operating principle of Centrifugal Compressor.
3.8.1 Name main parts of centrifugal compressors.
3.8.2 Explain function of each part of centrifugal compressors.
3.9 Identify and state the names of types of Rotary compressors.
3.9.1 Explain construction and working of following rotary compressors.
3.9.2 Sliding Vane compressor.
3.9.3 Lobe compressor.
3.9.4 Screw Compressor.
3.10 Explain the Reciprocating and Centrifugal Compressor operating problems, their causes and remedial action.
3.11 Describe the Compressor for CNG Filling Station.

Part-II: **THERMODYNAMICS.**
4. **To Understand the Fundamentals of Thermodynamics**
4.1 Define Thermodynamics.
4.2 Tabulate basic Units and Symbols of primary physical quantities.
4.3 Tabulate Derived Units and Symbols of important Thermodynamic Quantities in the SI System of Units.
4.4 Tabulate Dimensions and Units of different Dimensional Systems.
4.5 Describe the Units of Thermodynamic Quantities in different Dimensional Systems.
4.6 Define a System, Boundary and Surroundings.
4.7 Define and identify with examples .various types of Systems; Open System, Closed System, and Isolated System.
4.8 Identify and define various types of Walls, Rigid Wall, Diathermal Wall, and Adiabatic Wall.
4.9 Define and discuss Thermodynamic Properties.
4.10 Identify the properties which are unique to thermodynamics. State, Process and
Cycle.  
4.11 Define and give examples of the following;
a) Point Function.  
b) Path Function.  
c) Intensive Properties.  
d) Extensive Properties.

4.12 Define Thermodynamic Equilibrium., and various Equilibrium States.  
a) Mechanical Equilibrium  
b) Thermal Equilibrium  
c) Chemical Equilibrium

4.13 State Zeroth Law of Thermodynamics.

4.14 Define the Thermodynamic Process and various types of thermodynamic processes.  
i) Isothermal Process.  
ii) Isobaric Process  
iii) Isometric Process  
iv) Adiabatic Process  
v) Cyclic Process  
vi) Quasi-static Process  
vii) Non-Quasi-static Process  
viii) Reversible Process  
ix) Irreversible Process

5. To Understand Laws of Thermodynamics  
5.1 Define First Law of Thermodynamics.  
5.2 Explain and give expression of First Law of Thermodynamics.  
5.3 Explain Thermodynamic work.  
5.4 Define energy, Kinetic energy, Potential energy and Internal energy.  
5.5 Define Enthalpy.  
5.6 Define Second Law of Thermodynamics.  
5.7 Explain Second Law of Thermodynamics.  
5.8 Explain Entropy.

6. Understand Basics of Heat Transfer  
6.1 Define heat transfer and state modes of heat transfer.  
6.2 Define and explain heat transfer by Conduction.  
6.3 Define Fourier’s Law of heat conduction and give its mathematical expression.  
6.3.1 Define thermal conductivity of materials.  
6.3.2 Define thermal Resistance.  
6.3.3 Enlist factors effecting thermal conductivity.  
6.4 Define and explain heat transfer by Convection.  
6.4.1 Define free and forced Convection.  
6.4.2 Define Newton’ Law of Cooling and give its expression.  
6.4.3 Define coefficient of convective heat transfer.  
6.4.4 State factors effecting coefficient of convective heat transfer.  
6.5 Define and explain heat transfer by Radiation.  
6.6 Describe Convective heat transfer with change of phase.  
6.6.1 State applications of heat transfer by Convection with phase change.  
6.7 Describe Boiling and Condensation heat transfer.  
6.8 Describe overall heat transfer.  
6.9 State various factors that affect the heat transfer.  
6.9.1 Describe the affect of scale formation.  
6.9.2 Describe affect of temperature gradient during heat transfer.  
6.10 Define and give purposes of Insulations.  
6.10.1 State applications of Insulations.  
6.10.2 Define Critical Thickness of Insulation.  
6.10.3 Give characteristics of a good thermal Insulator.  
6.11 Give classification of Thermal Insulators.  
6.11.1 Enlist organic Thermal Insulators.  
6.11.2 Enlist inorganic Thermal Insulators.  
6.11.3 State characteristics and Engineering applications of some Thermal Insulators.
6.12 Describe cryogenic and multilayer insulation.

7. Understand Heat Exchanger Equipment

7.1 Define a Heat Exchanger.
7.2 Sketch a simple diagram to illustrate the basic function of a heat exchanger.
7.3 Give classification of Heat Exchangers.
7.4 Draw a single pass shell and tube type heat exchanger to show ten parts of Construction.
   7.4.1 Name common types of shell and tube heat exchanger.
   7.4.2 Describe Construction & Working of each type of Shell & Tube Heat Exchangers.
   7.4.3 Describe the two functions of Baffles installed in shell and tube type of heat Exchangers.
7.5 Describe Double Pipe Heat Exchanger.
7.6 Explain extended area air cooled heat exchangers.
7.7 Draw a diagram of a forced draught air cooler and describe its operation.
7.8 Explain the fundamental difference between direct and indirect fired heaters.
7.9 List three operational applications of indirect heaters at gas Production Facilities.
7.10 Describe the function of the fire tube in an indirect fired heater.
7.11 Draw the diagrams to show the basic construction of the
   i) Condensate Heater Reactor   ii) Condensate Stabilizer Reboiler
   iii) Glycol Reboiler.
7.12 Explain construction of a Boiler.
TOTAL CONTACT HOURS:  

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AIMS:
1. To teach the working of drilling rig and its components
2. To develop the understanding of drilling mud, coring and casing
3. To enable the student to understand the fundamental terminology of drilling technology and apply knowledge to solve drilling technology problems
4. To impart the basic knowledge of the production and well operations
5. To familiarize the students with the surface and sub surface production equipments

Detail Course Contents:

Part-I: Drilling Engineering (Part-A)

1. Introduction to Drilling Technology 02 Hours
   1.1 Different drilling techniques
   1.2 Cable tool drilling
   1.3 Rotary drilling

2. Introduction to Rotary Drilling 20 Hours
   2.1 Basic drilling rig components
   2.2 Basic drilling rig operations
   2.3 Hoisting system
   2.4 Rotary system
   2.5 Circulation system
   2.6 Power system
   2.7 Well control system

3. Drilling Fluids/Muds 08 Hours
   3.1 Functions of drilling fluids
   3.2 Properties of drilling fluids
   3.3 Types of drilling fluids
   3.4 Drilling hazards
   3.5 Drilling mud calculations
   3.6 Maintenance of mud system

4. Coring 04 Hours
   4.1 Coring methods and equipments
   4.2 Handling and sampling of cores

5. Well Casing and Cementing Practices 04 Hours
   5.1 Describe general function of casing strings.
   5.2 State different types of casing. Conductor, surface, intermediate and production.
5.3 Describe the casing accessories.
5.4 Describe Cement, its function and additives.
5.5 Describe the process of Cementing the Casing.
5.6 Briefly describe squeeze Cementing.

6. Understand Directional Drilling 06 Hours
6.1 Introduction to Directional Drilling.
6.2 State the Reasons for Directional Drilling.
6.3 Describe the Deflection Tools.

7. Understand Drilling Problems and Fishing 04 Hours
7.1 Introduction to Drilling Problems.
7.2 Describe Kicks.
7.3 Describe Shut In and Kill Procedures.
7.4 Introduction to Fishing operation.
7.5 State the problems leading to a Fishing Job.
7.6 Describe the procedure and Tools for Fishing a Pipe.
7.7 Describe Fishing for Junk and its Tools.

Part-2: Petroleum Production Technology

8. Introduction to Production Technology 02 Hours
8.1 Organization of Petroleum Production Company.
8.2 Production Systems.

9. Well Completions and Perforations 08 Hours
9.1 Introduction to well completion
9.2 Methods of production well completion
9.3 Completion equipment
9.4 Well completion procedures
9.5 Well perforations (design)

10. Work Over and Well Services 06 Hours
10.1 Introduction
10.2 Production logging
10.3 Production Problems

11. Wire line 07 Hours
11.1 Introduction
11.2 Surface Equipments
11.3 Down Hole service Tools
11.4 Sub surface well equipments

12. Oil and Gas Field Surface Production Equipments 10 Hours
12.1 Well Head
12.2 Surface Gathering system
12.3 Production separators

13. Oil and Gas Field Surface Processors 08 Hours
13.1 Crude oil dewatering
13.2 Crude oil storage
13.3 Produced water treatment
13.4 Pipeline scraper launcher/receiver

14. Well Stimulation 02 Hours
14.1 Introduction and Significance
14.2 Stimulation methods

15. Artificial Lift Methods

15.1 Introduction
15.2 Sucker rod pumping
15.3 Gas lifting
15.4 Subsurface electrical pumping
15.5 Subsurface hydraulic pumping
15.6 Selection of artificial lift methods
List of Practical: 192 Hours

1. Every week a laboratory Session should be arranged to familiarize students with the equipments studied in the previous theory class during the same week. For this purpose the teacher should first show the schematic diagram / sketch of the equipment labeled / model with important parts on an overhead projector and give brief description of the equipment. Then copies of the same sketch without labels be distributed among the students.

2. Relevant Audio-visual programs demonstrating oil field operations, processes, and equipments should be shown to the students.

3. Instructional tours should be arranged to visit various oil and gas fields and yards where the students can observe various oil and gas field operations, equipments, and safety Precautions. Every student should be advised to prepare in writing a different set of questions (at least there) on various relevant topics to be asked during the tour. The teacher should assist the students in composing and formulating questions.

4. To draw a sketch of rotary drilling rig indicating all the basic components and to practice identify different component.

5. To draw schematic diagrams of drill string components and bit and to practice identify each component with its relative position.

6. To draw sketches of different Drilling and Production Equipments studied in that week.

7. To study the cutting obtained during drilling.

8. To prepare Clay-Fresh Water Mud of given density in the laboratory.

9. To increase the density of a given mud of known amount and density by calculating the required amount of clay to be added in the mud.

10. To decrease the density of a given mud of known amount and density by calculating the required fresh water required to be added in the mud.

11. To measure density of mud with the help of Mud Balance.

12. To determine viscosity of mud with the help of Marsh Funnel.

13. To determine viscosity of mud with the help of Rotational Viscometer.

14. To determine Filtration properties of mud with the help of Filter Press.

15. Practice some numerical problems regarding mud calculations and drilling bit rotation speed.

Recommended Textbooks:


11. M.A. Qureshi, “Basic Production Course”, Oil & Gas Training Institute, Islamabad.
Part-1: Drilling Engineering

16. Understand oil and gas well drilling and different techniques of drilling
   1.1 Introduction to cable tool drilling and rotary drilling.
   1.2 Merits and demerits of cable tool drilling.
   1.3 Advantages of rotary drilling.
   1.4 Name different types of rotary drilling Rigs.
   1.5 Enlist different drilling companies in Pakistan and their shares.

17. Understand Rotary Drilling Method and Equipment.
   2.1 State general description of rotary drilling method.
   2.2 Enlist basic components of rotary rig.
   2.3 State five drilling Rig Operations.
   2.4 Describe Hoisting System.
      2.4.1 Identify the names of each of the component parts of the hoisting system.
      2.4.2 Explain following components parts of hoisting system.
         2.4.2.1 Describe functions and types of derricks.
         2.4.2.2 Distinguish between derrick and mast.
         2.4.2.3 Enlist applications of standard derricks.
         2.4.2.4 Describe factors which control the size of a derrick.
         2.4.2.5 Explain derrick loads and solve numerical problems on derrick Loads.
         2.4.2.6 State function of substructures.
         2.4.2.7 Describe functions of draw works.
         2.4.2.8 State function of drilling line.
         2.4.2.9 Describe functions of crown block.
         2.4.2.10 Describe functions of traveling assembly or travelling block hook.
   2.5 Describe Rotary System.
      2.5.1 Identify the names of each of the component parts of the Rotary System.
      2.5.2 Explain following components parts of Rotary System.
         2.5.2.1 Classify rotary bits and briefly describe each type. Also describe under reamers and hole openers
         2.5.2.2 Enlist components of drill string and briefly describe each component.
            a) Drill Pipe
            b) Drill Collar
            c) Stabilizers
            d) Various Subs
         2.5.2.3 Describe the following components of the Rotating Mechanism.
            a) Kelly and Kelly Bushing.
            b) Rotary table
            c) Swivel
            d) Down hole motors and turbines
            e) Top drive systems
   2.6 Describe Circulating System.
      2.6.1 Identify the names of each of the component parts of the Circulating System.
      2.6.2 Explain following components parts of Circulating System.
         a) State function of mud pumps and nomenclature to specify the type’s (duplex & triplex pumps).
         b) Enlist important qualities (features) of piston type mud pumps.
         c) Mud pit.
         d) Stand pipe and rotary hose.
e) Explain the Mud conditioning equipment. Shale shaker, Desander, Desilter and Degaser.

2.7 Describe Power System.
   2.7.1 Explain functions of prime movers.
   2.7.2 Briefly describe types of prime movers.

2.8 Describe Blowout Prevention (BOP) System.
   2.8.1 Explain BOP and give its types.
   2.8.2 Briefly describe BOP Operating system.

3. Understand Composition and functions of Rotary Drilling Fluids
   3.1 Describe basic functions of a drilling fluid.
   3.2 Enlist important properties of drilling mud which are tested routinely.
   3.3 Define and describe measurement of the drilling mud properties.
      3.3.1 Density and measurements of mud density with the help of mud balance.
      3.3.2 Viscosity and measurements of viscosity with Marsh Funnel and Rotational Viscometer.
      3.3.3 Gel strength and filtration loss.
      3.3.4 PH (acidity or alkalinity)
      3.3.5 Filtrate Analysis with the help of Filter Press.
      3.3.6 Sand content, and oil, water, solids contents.
   3.4 Describe components of a typical mud.
   3.5 Classify drilling mud’s.
      3.5.1 Describe composition and specific function of Water based mud’s.
      3.5.2 Describe composition and specific function of Oil based mud’s.
   3.6 Define lost circulation and describe its main causes.
   3.7 Describe problems associated with lost circulation.
   3.8 Describe methods of combating lost circulation.

4. Understand Coring Methods
   4.1 Introduction to coring; coring during drilling, and coring after drilling.
   4.2 Describe various methods of coring Conventional coring, conventional core head, diamond core head, wire line coring.
   4.3 Briefly describe the general operational considerations recommended for conventional coring.
   4.4 Describe the core handling and sampling procedures recommended by core laboratories.

5. Well Casing and Cementing Practices
   5.1 Describe general function of casing strings.
   5.2 State different types of casing. Conductor, surface, intermediate and production.
   5.3 Describe the casing accessories.
      5.3.1 Guide Shoe
      5.3.2 Float Collar and its purposes.
      5.3.3 Centralizers
      5.3.4 Well cleaners (Scratchers)
      5.3.5 Stop Collars
   5.4 Describe Cement, its function and additives.
   5.5 Describe the process of Cementing the Casing.
      5.5.1 Running the Casing.
      5.5.2 Mixing and pumping the Cement.
      5.5.3 Cementing.
   5.6 Briefly describe squeeze Cementing.

6. Understand the Directional Drilling
   6.1 Introduction to Directional Drilling.
   6.2 State the Reasons for Directional Drilling.
   6.3 Describe the Deflection Tools.
      6.3.1 Bent Sub and Mud Motor.
6.3.2 Steerable Drilling System, its components and Operation.
   a) Drill Bit or Turbodrill
   b) Mud Motor
   c) Navigation Sub
   d) Navigation Stabilizers
   e) Survey System

6.3.4 Rotary Steering System, its components and Operation.
   a) Non-Rotating Steerable Stabilizer
   b) Electronic Probe
   c) Reservoir Navigation or MWD Tool

6.3.5 Directional Bottom Hole Assemblies (BHA) and its types
   a) Packed Hole Assembly
   b) Pendulum Assembly
   c) Fulcrum Assembly

6.3.6 The Whipstock.

7. Understand Drilling Problems and Fishing
   7.1 Introduction to Drilling Problems.
   7.2 Describe Kicks.
      7.2.1 State causes of Kick.
      7.2.2 Describe Kick Indicators.
         a) Signs of a Kick in Progress.
         b) Signs of an Impending Kick.
   7.3 Describe Shut In and Kill Procedures.
      7.3.1 Shutting the well in.
      7.3.2 Killing the Well.
   7.4 Introduction to Fishing operation.
   7.5 State the problems leading to a Fishing Job.
   7.6 Describe the procedure and Tools for Fishing a Pipe.
      7.6.1 Jarring, Spotting and Milling.
      7.6.2 Inside Fishing Tools. Tap and Spear.
      7.6.3 Outside Fishing Tools. Die Collar and Overshot.
   7.7 Describe Fishing for Junk and its Tools.
      7.7.1 Finger Type Junk Basket.
      7.7.2 Fishing Magnet.
      7.7.3 Junk Sub and Rope Spear.
      7.7.4 Core Type Junk Basket.

Part-II: Petroleum Production

8. Understanding Organization of petroleum Company
   8.1 State the objective of a petroleum exploration and production of company.
   8.2 Describe the organizational setup of typical petroleum Production Company;
      8.2.1 Technical Service Departments.
      8.2.2 Administrative Service Department.
   8.3 Enlist different Petroleum production companies in Pakistan and their shares.

9. Understanding of well completion
   9.1 Introduction to well completion.
   9.2 Enlist the methods (categories) of production well completion.
   9.3 Describe each of the following categories of well completion with the help of schematic diagrams and state advantages and disadvantages as well.
      9.3.1 Open hole completion.
      9.3.2 Screen liner Completion:
         a) Screen and Liner Completion
         b) Perforated Liner completion.
      9.3.3 Perforated casing completion.
7.4 Introduction to completion procedures.
7.5 Describe procedure of the following types of completions with help of relevant schematic diagrams.
   i. Single completion (with packer)
   ii. Dual zone single completion
   iii. Single selective completion.
   iv. Multiple completions.
7.6 Introduction to perforating wells.
7.7 Describes bullets perforators and jet perforators.

8. Understand Work over and Well Services
8.1 Introduction to work over and well services.
8.2 State the objectives of production logging and enlist its potential benefits.
8.3 State what is meant by production logging and enlist various production logging tools.
8.4 Describe the specific purpose of production logging.
8.5 Identify well problems that can be solved with the help of production logging.
8.6 Briefly describe the following production problems and their solution.
   a) Watering-out/Gassing-out
   b) Sand control.
   c) Isolating depleted production zones.
   d) Paraffin deposition.
   e) Hydrate formation.
   f) Crooked tubing.

9. Understand Wireline Tools and their Functions
9.1 Introduction to wireline.
9.2 Explain the arrangement of wireline equipment with the help of a sketch.
9.3 Briefly describe the following equipments stating their functions. Draw sketches where necessary.
   a) Surface Equipment; reels, weight indicators, line speed indicators, rope socket, Wireline, stuffing boxes, blowout preventers, lubricators, Line wipers, oil traps.
   b) Down hole Service Tools: Impression block, tubing swage, paraffin cutter (gauge cutter), sand bailer, spear, kick over tool, bottom hole Pressure pump, sidewall cutter, shifting or positioning tool.
   c) Subsurface Well Equipment: tubing and tubing strength rating, packers and its types, landing nipples, sliding sleeve valve, locating and locking mandrels, blast joint, flow coupling, tubing safety (storm choke), bottom hole regular, pack off anchor, polished nipple, valve mandrel.

10. Understand Oil field surface production equipment
10.1 Give brief description of the following topics show sketches where necessary,
   i. Functions of wellhead.
   ii. Function and types of Christmas tree.
10.2 Enlist Christmas tree equipment.
10.3 Briefly describe various manual Valves used in the Christmas tree.
10.4 Describe various types of chokes.
10.5 Describe various types of Safety values.
10.6 Briefly describe a gathering system.
10.7 Explain arrival Manifold with the help of a sketch.
10.8 Enlist main factions of separators.
10.9 Enlist physical factors necessary for separators to work.
10.10 Describe the following
   a) Primary Separation.
   b) Coalescence.
   c) Secondary Separation.
      i) Mist Extraction.
      ii) Dissolved gas separation.
10.11 State internal fittings of Separators and their function.
10.12 Give classification of separators and state their Advantages and Limitations.
10.13 Explain operation of each type of separator.

11. **Understand Oil Field Surface Processes**
   11.1 Describe crude oil desalting process with the help of a schematic diagram of a Desolater.
   11.2 Describe operating variables of desalting process.
   11.3 Describe atypical field desalting process flow with the help of a sketch.
   11.4 Explain the function and principles of a gun barrel for crude oil dewatering showing a Schematic diagram.
   11.5 Describe principles of operation of a gas boot.
   11.6 Describe function of a gas boot and flow tank combination showing a schematic diagram.
   11.7 Describe the two categories of atmospheric fixed roof tanks.
   11.8 Enlist various equipments and systems of the atmospheric fixed roof tank.
   11.9 Describe construction of an atmospheric fixed roof tank by showing a sketch.
   11.10 Explain function of the pressure/vacuum safety valve with help a schematic sketch.
   11.11 Introduction to produced water treatment,
   11.12 Describe various equipments for water treatment. Show diagrams of skim Tanks, oil skimmer pit, and floatation unit.
   11.13 Describe the function and types of pipeline scrapper launcher-receiver.
   11.14 Illustrate the procedure for launching and receiving pipeline scraper.

12. **Understand Methods of Well Stimulation**
   12.1 Introduction to stimulation techniques.
   12.2 State various acidizing and hydraulic fracturing treatments and their applications.
   12.3 State the basis for selecting stimulation candidates.
   12.4 Describe important generalizations to be made concerning the potential benefits of stimulation.

13. **Understand Artificial Lift Methods**
   13.1 Enlist the most common methods of artificial lift.
   13.2 Enlist the component parts of a sucker rod pumping installation and give brief introduction to each part with the help of schematic sketches.
   13.3 Introduction of gas lifting.
   13.4 Introduction to subsurface electrical pumping.
   13.5 Describe types of subsurface hydraulic pumping.
   13.6 Describe other artificial lift methods; turbine pump, plunge lift, progressive Cavity pump.
   13.7 Enlist factors to be considered for selection of artificial lift method.
Course Objectives: After studying this course the students will understand the following.
1. Fundamentals of the solid, liquid, and gaseous fuels.
2. Important properties of fuels.
3. Fundamentals of combustion process and combustion equipment.

Detail Course Contents:

2 INTRODUCTION TO FUELS 2 Hours
2.1 Understand Fuel.
2.2 Classification of Fuels.
2.3 Advantage and disadvantage of solid, liquid and gaseous fuels.

3 Solid Fuels 10 Hours
3.1 Wood.
3.2 Coal.
3.3 Coal Ranks.
3.4 Coal Types.
3.5 Coal Analysis.
3.6 Miscellaneous Solid Fuels.

4 Coal Conversion Technology 10 Hours
4.1 Coal Carbonization.
4.2 Coal Gasification.
4.3 Coal Liquefaction.

5 Liquid Fuels 2 Hours
5.1 Crude Oil.
5.2 Petroleum Refinery Products.
5.3 Other Liquid Fuels.

6 Gaseous Fuels 8 Hours
6.1 Natural Gas.
6.2 L.P.G.
6.3 Manufactured Gases.
6.4 By Product Gases.

7 Combustion 10 Hours

7.1 Define Combustion.
7.2 Combustion Process.
7.3 Heat Capacity.
7.4 Heat of Formation.
7.5 Heat of combustion and its measurements.
7.6 Inflammability Limits.
7.7 Ignition Temperature.
7.8 Combustion Calculations.

8 Fuel Burning Equipment 16 Hours

8.1 Gas Burners.
8.2 Oil Burners.
8.3 Coal Burning Equipments.

9 Non Conventional and Energy Resources 6 Hours

9.1 Introduction of Non Conventional and Energy.
9.2 Nuclear Energy.
9.3 Solar Energy.
9.4 Wind Energy
9.5 Tidal Energy.

Recommended Textbooks:
List of Practical:

1. To understand the safety in the Laboratory.

2. To differentiate different types of coals by Rank according to ASTM Standards.

3. Tabulate advantages and disadvantages of solid, liquid and gaseous fuels.

4. To determine the Moisture Contents of coal sample.

5. To determine the Volatile Matter of coal sample.

6. To determine the Ash in coal sample.

7. To determine the %age of Nitrogen in a coal sample.

8. To determine the %age of Sulfur in a coal sample.

9. To study the Coal Carbonization process.

10. To study different coal Gasification processes.

11. To study different direct coal Liquefaction processes.

12. To determine the types of fuels with the help of flame color and propagation.
13. To determine the Weathering or Slacking Index of Coal sample.
14. To determine the Swelling Index of Coal sample.
15. To determine the coking properties of coal by Sheffield Coking Test Apparatus.
16. To draw sketch and study the Atmospheric and High Pressure Gas Burners.
17. To draw sketch and study the Vaporizing Oil Burner.
18. To draw sketch and study the Rotating-cup Oil Burner.
19. To draw sketch and study the Atomizing Oil Burners.
20. To draw sketch and study the Overfeed Stokers.
21. To draw sketch and study the Underfeed Stokers.
22. To draw sketch and study the Pulvirizer and Pulverized coal Burner.
23. To prepare Gobar Gas in the Laboratory by Gobar Gas Mini Plant.
24. To solve numerical problems related to Flue Gas Analysis.
25. To determine the Carbon residue of liquid fuels by Canradson Carbon Residue Apparatus.
26. To determine the Calorific Value of coal by Bomb Calorimeter.
27. To determine the Calorific Value of Liquid Fuel by Bomb Calorimeter.
28. To determine the Porosity of Coal and Coke.

PCT-223 Instructional Objectives:

2. **Introduction to Fuels**
   1.1 Define Fuels.
   1.2 Give Classification of Fuels.
   1.2.1 Classification based on Chemical Nature.
   1.2.2 Classification based on Physical State.
1.2.3 Classification based on Preparation.

1.3 Give advantage and limitation of Solid, Liquid and Gaseous Fuels.

3. **Solid Fuels**

   2.1 Describe Wood.
      2.1.1 Introduction of wood and its uses.
      2.1.2 Describe wood Carbonization.
      2.1.3 Enlist wood carbonization products.
      2.1.4 Describe is Wood Char. Give its uses.

   2.2 Describe Peat.
      2.2.1 Origin of Peat.
      2.2.2 Properties and uses of Peat.

   2.3 Describe Coal.
      2.3.1 Describe origin of coal.
      2.3.2 Describe theories regarding origin of coal.
      2.3.3 Points in favor of different theories.

   2.4 Describe ranks of coal.
      2.4.1 Explain Lignite.
      2.4.2 Explain sub-bituminous coal.
      2.4.3 Explain Bituminous coal.
      2.4.4 Explain semi-anthracite coal.
      2.4.5 Explain anthracite coal.

   2.5 Describe types of coal
      2.5.1 Explain banded coal.
      2.5.2 Explain non-banded coal.
      2.5.3 Caking and coking coal.

   2.6 Describe Petrographic constituents of coal.
      2.6.1 Vitrain.
      2.6.2 Clarain.
      2.6.3 Durain.
      2.6.4 Fussain.

   2.7 Describe coal analysis.
      2.7.1 Explain proximate analysis.
      2.7.2 Explain ultimate analysis.

   2.8 Describe some miscellaneous solid fuels.
      2.8.1 Bagasse.
      2.8.2 Cow dung.
      2.8.3 Rice husk.
      2.8.4 Tanbark.
      2.8.5 Cotton crop remain.
      2.8.6 Briquettes.

4. **Coal Conversion Technology**

   3.1 Define Coal Carbonization.
      3.1.1 Give types of coal carbonization.
      3.1.2 Explain low temp. Carbonization.
      3.1.3 Explain high temp. Carbonization.
      3.1.4 Explain semi coke.
      3.1.5 Describe coke.
      3.1.6 Describe coal tar.
      3.1.7 Explain distillation of coal tar.
      3.1.8 Explain the products of tar distillation.
      3.1.9 Compare low and high temperature Carbonization Processes.
3.2 Understand coal gasification.
   3.2.1 Introduction of coal gasification.
   3.2.2 Describe the steps involved in coal gasification.
   3.2.3 Explain different gasification processes.
   3.2.4 Describe fixed-bed process.
   3.2.5 Describe underground gasification.

3.3 Understand Coal Liquefaction.
   3.3.1 Describe coal liquefaction process.
   3.3.2 Describe direct coal liquefaction.
   3.3.3 Describe paralyses of coal.
   3.3.4 Describe solvent extraction process.
   3.3.5 Describe indirect coal liquefaction.
   3.3.6 i) Fischer-Tropsch process.
   ii) Methanol process.
   iii) Methanol to gasoline process.

4 Liquid Fuels
   4.1 Describe crude oil.
   4.2 Describe petroleum refinery products and enlists main products.
      4.2.1 Gasoline.
      4.2.2 Naphtha.
      4.2.3 Kerosene.
      4.2.4 Diesel.
      4.2.5 Benzol.
      4.2.6 Alcohol.
      4.2.7 Tar Sand.
      4.2.8 Fuel Oil.
      4.2.9 Gas Oil.

5 Gaseous Fuels
   5.1 Introduction of Gaseous Fuels.
   5.2 Describe Natural Gas.
   5.3 Describe coal bed methane.
   5.4 Describe manufactured gases.
   5.5 Explain the production, composition and uses of following gases.
      5.5.1 Gobar (Bio) Gas.
      5.5.2 Sewage Gas.
      5.5.3 L.P.G.
      5.5.4 CNG.
      5.5.5 LNG.
      5.5.6 Producer Gas.
      5.5.7 Water gas and carbureted water gas.
   5.6 Describe the following by-product gases.
      5.6.1 Refinery Gas.
      5.6.2 Blast furnace gas.
      5.6.3 Coke oven gas.
      5.6.4 Coal gas.

6 Combustion
   6.1 Define Combustion.
   6.2 Describe combustion process.
      6.2.1 Enlist requirements of good combustion.
6.2.2 Describe the types of combustion process.
6.3 Explain the theoretical air for combustion.
6.4 Explain excess air.
6.5 Define a flame.
   6.5.1 Give the types of flames.
6.6 Define Smoke.
6.7 Definedraft.
   6.7.1 Describe types of drafts.
6.8 Define heat capacity.
6.9 Define specific heat.
6.10 Define heat and combustion.
6.11 Define heat and caloric value.
   6.11.1 Define lower and higher heating value.
   6.11.2 Understandcolorimeter.
   6.11.3 Explain combustion and working of different type of calorimeters.
      i) Bomb calorimeter
      ii) Boy’s calorimeter.
      iii) Junker calorimeter.
6.12 Define ignition temperature.
   6.12.1 Give methods of measuring of ignition temperature.
6.13 Understand limit of inflammability.
   6.13.1 Define upper and lower limit of inflammability.
   6.13.2 Describe factor effect on limit of inflammability.
6.14 Describe the calculations based on combustion.

7 Fuel Burning Equipment
7.1 Introduction to Gas Burners.
   7.1.1 Give types of Gas Burners.
   7.1.2 Explain construction and working of Atmospheric Gas Burner.
   7.1.3 Describeconstruction and working of High Pressure Gas Burner
7.2 Introduction to oil burners.
7.3 Explain construction and working of following oil burners.
   i) Air atomizing burner.
      a) Low pressure atomizing.
      b) High pressure atomizing.
   ii) Steam atomizing burner.
   iii) Oil pressure atomizing burner.
   iv) Rotary burner.
   v) Vaporizing burner.
7.4 Introduction to coal burning equipment.
   7.4.1 Enlist type of coal burning equipment.
   7.4.2 Describe over feed firing.
   7.4.3 Describe hand firing.
   7.4.4 Describe following types of mechanical stoker.
      i) Travelling grate stoker.
         a) Chain grate stoker.
         b) Bar grate stoker.
      ii) Vibrating grate stoker.
      iii) Spreader stoker.
   7.4.5 Describe under feed firing.
      i) Single Retort.
      ii) Multiple Retort.
7.4.6 Describe pulverized coal firing.
7.4.7 Explain construction and working of pulverized.
7.4.8 Give advantage and disadvantage of pulverized coal firing.
7.4.9 Explain fluidized bed combustion of coal.
7.4.10 State Advantages and Disadvantages of fluidized bed combustion of coal.

8 Non-Conventional Energy Resources
8.1 Introduction of renewable energy.
8.2 Explain Nuclear energy. Also Describe Nuclear Power Plant.
   8.2.1 Describe nuclear fusion.
   8.2.2 Describe nuclear fission.
8.3 Explain Solar energy.
8.4 Explain Wind energy.
8.5 Describe Tidal energy.
8.6 Describe Geothermal energy.

PCT-233 INSTRUMENTAL METHODS OF ANALYSIS

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Pre-requisites: None
Course Objectives: Students are enabled to understand different analytical techniques. Use of different analytical processes and their applications with reference to petrochemical industry.

Detail Course Contents:

1. **QUANTITATIVE AND QUALITATIVE ANALYSIS**  
   06 Hours
   1.1 Definition, Importance in daily life, industrial importance.
   1.2 Types of analysis, quantitative analysis, qualitative analysis, volumetric analysis, gravimetric analysis.
   1.3 Instrumental method of analysis, conventional method of analysis.

2. **SAMPLING**  
   02 Hours
   2.1 Sampling techniques for liquid, solid and gas.
   2.2 Storage of sample

3. **COLORIMETRY**  
   04 Hours
   3.1 Fundamental laws of colorimetry.
   3.2 Bouger’s law, Beer’s law
   3.3 Failures of Bouger-Beer’s law
   3.4 Photo electric effect
   3.5 Barrier layer cell construction and working
   3.6 Photo emissive tube construction and working
   3.7 Photo cell
   3.8 Single beam photo meter, construction and working
   3.9 Double beam photo meter, construction and working
   3.10 Bouger-Beer’s law applied to photo electric colorimetry

4. **SPECTRO PHOTO METER**  
   06 Hours
   4.1 Spectrum of light, visible spectra
   4.2 Ultra violet spectra
   4.3 Infra red spectra
   4.4 Absorption spectra, emission spectra
   4.5 Molecular structure, origin of spectra
4.6 Spectro photo meter  
4.7 Construction and working of a spectro photo meter  
4.8 Ultra violet spectro photo meter  
4.9 Construction and working parts  
4.10 Infra red spectro photo meter  
4.11 Construction and working parts

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<th>REFRACTIVE INDEX AND REFRACTOMETERY</th>
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<td>Effect of temperature</td>
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<td>5.3</td>
<td>Refractometer</td>
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<td>Fischer refectrometer, construction and working</td>
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<td>Phase polarized light</td>
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<td>Low rotatory dextro rotator</td>
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<td>Calculation of optical rotation</td>
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<td>6.5</td>
<td>Specific rotation</td>
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<td>Polarimeter, construction and working</td>
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<td>Construction of analyzer and polarizer</td>
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<td>7.1</td>
<td>Definitions</td>
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<td>Principal of gas chromatography \ study of gas chromatography essential parts.</td>
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<th>pH VALUE AND CONDUCTOMETRY</th>
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<td>8.1</td>
<td>Understand pH value.</td>
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<td>8.2</td>
<td>Understand buffer solution.</td>
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</table>
8.3 Explain the construction and working of direct reading PH meter.

8.4 Define resist and conductivity.

8.5 Define specific resistance and specific conductance with units.

8.6 Describe the measurement of conductivity by conductivity cell.

**Recommended Textbooks:**


**List of Practical:**

1. Weighing practice on analytical balance.
2. Weighing practice on digital balance.
3. Preparation of N/10 solution No. of primary standard Na₂CO₃, oxalic acid.
4. Determination of normality of approximately prepared solution by titrating against some standard solution, HCl, H₂SO₄ and nowlt solution.
5. Preparation of indicator solution
   i  Phenolphthalein solution.
   ii  Methyl orange solution.
7. Preparation of Standard Solution of HCl.
8. Preparation of Standard Solution of NaOH.
10. Standardization of 0.1 N Iodine Solution with Na₂S₂O₃ Solution.
11. Standardization of Ba₂S₂O₃ Solution with known Iodine Solution.
12. Determination of Antimony content in Antimony salt.
15. Redox titration using Internal indicators.
17. Gravimetric determination of free water (moisture contents) and combined water (Water of crystallization)
18. Study the reflection, refraction and dispersion of light using Prisms.
19. Determination of the absorbance and transmittance for different concentration of Colored solution by Colorimeters.
20. To study the construction and working of Abbe’s refractometer.
21. To study the construction and working of Fisher refractometer.
22. To study the construction and working of polarimeter.
23. Measurement of refractive index of various liquid by using Abbe’s refractometer.
25. Determination of calcium, sodium, potassium by using photometer.
26. Determination of specific rotation of optical active materials using Polarimeter.
27. Determination of PH value of industrial samples by
   (1) Indicating methods
   (2) PH paper method
   (3) Pocket comparator method
   (4) PH meter (Direct reading)
   (5) Electroplating.
28. Preparation of Buffer solutions of different PH values.
29. Study of gas chromatography and determination of different Gases using Gas chromatography.
32. Determination of Ammonia in water by Nessler reagent in colorimetry.
33. Determination of concentration of CuSO₄ sample by visual colorimetry.
34. Colorimetric determination of Nickel with dimethyloxime (Nephelometry).

35. Determination of Manganese in Steel by using spectronic 21 (Auto – recording).
36. Study of U-V spectro photometer.

37. To determine the absorbance and transmittance of solutions by Photometer.

**Tests For Sugar Industry**

38. To determine the purity of Cane Juice after Crushing.
39. To determine the purity of Misscuit.
40. To determine the purity of LacquerBrix.
41. To determine the purity of Molasses.
42. To determine the purity of runoff Molasses.
43. To determine the purity of Refine Misscuit.
44. To determine the purity of Mud.
45. To determine the purity of Syrup Brix.
PCT-233 **Instructional Objectives:**

1. **UNDERSTAND QUANTITATIVE AND QUALITATIVE ANALYSIS**
   1.1 Understand quantitative analysis.
      1.1.1 Define quantitative analysis.
      1.1.2 Illustrate importance of quantitative analysis.
      1.1.3 Distinguish quantitative analysis and qualitative analysis.
   1.2 Understand volumetric analysis.
      1.2.1 Describe volumetric analysis with types.
      1.2.2 Enlist types of reagent based volumetric analysis.
      1.2.3 Define indicator, distinguish internal and universal indicator.
   1.3 Understand gravimetric analysis.
      1.3.1 Describe gravimetric analysis apparatus.
      1.3.2 Calculate free water content.
      1.3.3 Calculate combined water content.
      1.3.4 Explain desiccators.
      1.3.5 Enlist desiccants.
   1.3 Define I.M.A

1.2 **SAMPLING**

1.4 Understand sampling.
1.5 Define sampling.
1.6 Describe method of sampling.
1.7 Explain sampling of liquid, for liquid, solid, and gas liquid.
1.8 Illustrate storage of samples.
2 COLORIMETRY

2.1 Understand colorimetry.

2.2 Define colorimetry.

2.3 Define transmittance and absorbance.

2.4 Enlist photometric law.
   5.4.1 Define beer’s law.
   5.4.2 Define bugger’s law.
   5.4.3 Given condition for which bugger’s beer’s law hold.
   5.4.4 Given condition for which bugger’s beer’s law fail.

2.5 Understand photo electric colorometry.

2.6 Define photo electric colorometry.

2.7 Enlist different photo detector.

2.8 Explain the working and construction of photo cell.

3 REFRACTOMETRY

3.1 Understand refractometry.

   4.1.1 Explain refraction of light.
   4.1.2 Explain refractive index.
   4.1.3 Explain effect of Temperature on refractive index.

3.2 Define refractometry.

   4.2.1 Give application of refractometry.
   4.2.2 Explain construction and working of Abb’s Refractometer.
   4.2.3 Explain the construction and working of Fisher Refractrometer.

4 POLARIMETERY

4.1 Understand polarimetry.

4.2 Define plane polarized light.

4.3 Define optical active material and optical activity.

4.4 Define levorotatory and dextrorotatory.

4.5 Give examples of Optical active material.

4.6 Draw working diagram of polarimeter.

4.7 Enlist parts of polarimeter.

4.8 Explain the function of different parts of polarimeter.
5 GAS CHROMATOGRAPHY

5.1 Explain gas chromatography.

5.2 Describe principle of gas chromatography.

5.3 Explain the construction and working of detectors used in gas chromatography.
   
   (A) Conductivity detector.
   
   (B) Thermal conductivity detector.
   
   (C) Flame conijation detector.
   
   (D) Density box detector.

6 PH VALUE AND CONDUCTOMETERY

6.1 Understand Ph value.
   
   10.1.1 Define pH value.
   
   10.1.2 Define POH value.
   
   10.1.3 Enlist applications of pH measurement.

6.2 Understand buffer solution.
   
   10.2.1 Define buffer solution.
   
   10.2.2 Give properties of buffer solution.

6.3 Explain the construction and working of direct reading pH meter.

6.4 Define resist and conductivity.

6.5 Define specific resistance and specific conductance with units.

6.6 Describe the measurement of conductivity by conductivity cell.
PCT-243 PETROCHEMICAL INDUSTRIES-1

Total Contact Hours

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Pre-requisites: Applied Chemistry

AIMS:

1. To assist the student in understanding fundamental Principles of petrochemicals.
2. Understand important manufacturing procedure employed by modern petrochemical industries.
3. Understand different chemical processes commonly employed in petrochemical industries.
4. Chemical production equipment related to these processes.
5. Enable the student to draw flow sheet diagram.

Detail Course Contents:

1. INTRODUCTION TO PETROCHEMICAL
   1.1 Definition and source of Petrochemicals.
   1.2 Applications of Petrochemicals.

2. NOMENCLATURE OF ORGANIC COMPOUNDS
   2.1 Classification of organic compounds.
   2.2 General Formula and Functional Groups.
   2.3 Nomenclature (Common and IUPAC).

3. INDUSTRIAL GASES IN PETROCHEMICAL PROCESSING
   6 Hours
   3.1 Hydrogen.
   3.2 Nitrogen.
   3.3 Oxygen.
   3.4 Ammonia.

4. CHEMISTRY OF PETROCHEMICALS
   4 Hours
   4.1 Introduction to Petrochemical Processing.
   4.2 Main Chemical Processes employed for Petrochemical Manufacturing.
   4.3 Petrochemicals produced by each Process.

5. PETROCHEMICALS FROM METHANE AND SYNTHESIS GAS
   10 Hours
   5.1 Synthesis Gas.
   5.2 Urea.
   5.3 Nitric Acid.
5.4  Hydrazine.
5.5  Hydrogen Cyanide.
5.6  Methanol.
5.7  Chlorinated Methanes.
5.8  Methyl Amines.
5.9  Nitro-alkanes.
5.10 Formaldehyde.

6. **PETROCHEMICALS FROM ETHYLENE**  
   10 Hours
   6.1  Acetylene.
   6.2  Ethylene oxide.
   6.3  Ethylene glycol.
   6.4  Ethanol.
   6.5  Acetaldehyde.
   6.6  Acetic Acid.
   6.7  Vinyl Chloride.
   6.8  Vinyl Acetate.
   6.9  Butadiene.

7. **PETROCHEMICALS FROM PROPYLENE AND HIGHER OLEFINs**  
   6 Hours
   7.1  Isopropyl alcohol.
   7.2  Acetone.
   7.3  Propylene Oxide.
   7.4  Propylene Glycol.
   7.5  Heptenes.
   7.6  Acrylonitrile.

8. **PETROCHEMICALS FROM BTX**  
   16 Hours
   8.1  Benzene
   8.2  Cyclohexane.
   8.3  Ethylbenzene
   8.4  Styrene.
   8.5  Cumene.
   8.6  Nitrobenzene.
   8.7  Chlorobenzene.
   8.8  Toluene
   8.9  Benzene.
   8.10 Benzene and xylene.
   8.11 Phenol.
   8.12 Nitrotoluene.
   8.13 Benzaldehyde.
   8.14 Teraphthalic Acid.
   8.15 Diethyl Terephthalate.
List of Practical:
1. To understand the safety in the process Lab.
2. Relevant Audio-visual programs demonstrating chemical operations, processes, and equipments should be shown to the students.
3. Instructional tours should be arranged to visit various petrochemical industries where the students can observe various petrochemical operations, equipments, and safety Precautions. Every student should be advised to prepare in writing a different set of questions (at least there) on various relevant topics to be asked during the tour. The teacher should assist the students in composing and formulating questions.
4. To study and make Models of Different Processes and Industries.
5. To understand different Processes with the help of Videos.
6. To prepare Models of different processes.
7. To understand different Chemical Reactions by practicing.
8. To understand different processes by Drawing Flow Diagrams.
9. Preparation of Acetylene from Calcium Carbide.
10. Preparation of Ethylene from Methanol and Sulphuric acid.
11. Preparation of Ammonia from Ammonium Sulphate and Potassium Cyanate.
12. Preparation of Acetone from Calcium Acetate.
13. Preparation of Diethyl Ether from Ethyl Alcohol and H₂SO₄.
14. Preparation of Acetaldehyde from Ethyl Alcohol, Sodium Dichromate and H₂SO₄.
15. Preparation of Nitrobenzene from Benzene and Nitric Acid.
16. Preparation of Chloroform from Bleaching Powder and Acetone.

17. Preparation of Picric Acid (Yellow Dye).

18. Preparation of Aspirin.


20. To study the Hydrolysis of Esters.

**Recommended Textbooks:**


**PCT-243 Instructional Objectives:**

17. **INTRODUCTION TO PETROCHEMICALS**
   1.1 Define Petrochemicals.
   1.2 Give some examples of Petrochemicals.
   1.3 Describe main raw materials of Petrochemicals.
   1.4 Describe the importance of Petrochemicals in daily life.

2. **NOMENCLATURE OF ORGANIC COMPOUNDS**
   2.1 Define organic Chemistry.
   2.2 Differentiate between organic and inorganic compounds.
   2.3 Give classification of Organic Compounds.
   2.4 Define Hydrocarbons. Give their classification.
   2.5 Write general formula of each class of Organic Compound.
2.6 Write functional group for each class of Organic Compound.
2.7 Describe Nomenclature (Common and IUPAC) of Organic Compounds.
   2.7.1 Nomenclature of Alkanes.
   2.7.2 Nomenclature of Alkenes.
   2.7.3 Nomenclature of Alkynes.
   2.7.4 Nomenclature of Alkyl Halides.
   2.7.5 Nomenclature of Alcohols.
   2.7.6 Nomenclature of Aldehydes and Ketones.
   2.7.7 Nomenclature of Carboxylic Acids.

3. INDUSTRIAL GASES IN PETROCHEMICAL PROCESSING
3.1 Introduction to Hydrogen.
   3.1.1 Describe manufacturing process of Hydrogen.
   3.1.2 State properties and uses of Hydrogen.
3.2 Introduction to Nitrogen.
   3.2.1 Describe manufacturing process of Nitrogen.
   3.2.2 State properties and uses of Nitrogen.
3.3 Introduction to Oxygen.
   3.3.1 Describe manufacturing process of Oxygen.
   3.3.2 State properties and uses of Oxygen.
3.4 Introduction to Ammonia.
   3.3.1 Describe manufacturing process of Ammonia.
   3.3.2 State properties and uses of Ammonia.

4. CHEMISTRY OF PETROCHEMICALS PROCESSES
4.1 Introduction to Petrochemical Processing.
4.2 State Main Chemical Processes employed for Petrochemical Manufacturing.
4.3 Describe following types of Chemical Process and enlist Petrochemicals produced by these types of Processes.
   4.3.1 Hydrogenation and Dehydrogenation.
   4.3.2 Amination.
   4.3.3 Alkylation.
   4.3.4 Halogenation and Hydrohalogenation.
   4.3.5 Esterification.
   4.3.6 Hydration and Hydrolysis.
   4.3.7 Nitration.
   4.3.8 Oxidation.
   4.3.9 Polymerization.

5. PETROCHEMICALS FROM METHANE AND SYNTHESIS GAS
5.1 Describe the manufacturing of Synthesis Gas.
   5.1.1 Name the raw materials and chemical reaction for the manufacture of Synthesis Gas.
   5.1.2 Give process description, Flow diagram and uses.
   5.1.3 Enlist Petrochemical derived from Synthesis Gas.
5.2 Describe the manufacturing of Ammonia.
   5.2.1 Name the raw materials and chemical reaction for the manufacture of Ammonia.
   5.2.2 Give process description, Flow diagram and uses.
5.3 Describe the manufacturing of Urea.
   5.3.1 Name the raw materials and chemical reaction for the manufacture of Urea.
   5.3.2 Give process description, Flow diagram and uses.
5.4 Describe the manufacturing of Nitric Acid.
5.4.1 Name the raw materials and chemical reaction for the manufacture of Nitric Acid.
5.4.2 Give process description, Flow diagram and uses.
5.5 Describe the manufacturing of Hydrazine.
4.5.1 Name the raw materials and chemical reaction for the manufacture of Hydrazine.
5.5.2 Give process description, Flow diagram and uses.
5.6 Describe the manufacturing of Hydrogen Cyanide.
5.6.1 Name the raw materials and chemical reaction for the manufacture of Hydrogen Cyanide.
5.6.2 Give process description, Flow diagram and uses.
5.7 Describe the manufacturing of Methanol.
5.7.1 Name the raw materials and chemical reaction for the manufacture of Methanol.
5.7.2 Give process description, Flow diagram and uses.
5.7.3 Enlist Petrochemical derived from Methanol.
5.8 Describe the manufacturing of Chlorinated Methanes.
5.8.1 Name the raw materials and chemical reaction for the manufacture of Chlorinated Methanes.
5.8.2 Give process description, Flow diagram and uses.
5.9 Describe the manufacturing of Methyl Amines.
5.9.1 Name the raw materials and chemical reaction for the manufacture of Methyl Amines.
5.9.2 Give process description, Flow diagram and uses.
5.10 Describe the manufacturing of Nitro-alkanes.
5.10.1 Name the raw materials and chemical reaction for the manufacture of Nitro-alkanes.
5.10.2 Give process description, Flow diagram and uses.
5.11 Describe the manufacturing of Formaldehyde.
5.11.1 Name the raw materials and chemical reaction for the manufacture of Formaldehyde.
5.11.2 Give process description, Flow diagram and uses.

6. PETROCHEMICALS FROM ETHYLENE
6.1 Describe the manufacturing of Acetylene.
6.1.1 Name the raw materials and chemical reaction for the manufacture of Acetylene.
6.1.2 Give process description, Flow diagram and uses.
6.2 Describe the manufacturing of Ethylene oxide.
6.2.1 Name the raw materials and chemical reaction for the manufacture of Ethylene oxide.
6.2.2 Give process description, Flow diagram and uses.
6.3 Describe the manufacturing of Ethylene glycol.
6.3.1 Name the raw materials and chemical reaction for the manufacture of Ethylene glycol.
6.3.2 Give process description, Flow diagram and uses.
6.4 Describe the manufacturing of Ethanol.
6.4.1 Name the raw materials and chemical reaction for the manufacture of Ethanol.
6.4.2 Give process description, Flow diagram and uses.
6.5 Describe the manufacturing of Acetaldehyde.
6.5.1 Name the raw materials and chemical reaction for the manufacture of
6.5.2 Give process description, Flow diagram and uses.

6.6 Describe the manufacturing of Acetic Acid.
6.6.1 Name the raw materials and chemical reaction for the manufacture of Acetic Acid.
6.6.2 Give process description, Flow diagram and uses.

6.7 Describe the manufacturing of Vinyl Chloride.
6.7.1 Name the raw materials and chemical reaction for the manufacture of Vinyl Chloride.
6.7.2 Give process description, Flow diagram and uses.

6.8 Describe the manufacturing of Vinyl Acetate.
6.8.1 Name the raw materials and chemical reaction for the manufacture of Vinyl Acetate.
6.8.2 Give process description, Flow diagram and uses.

6.9 Describe the manufacturing of Butadiene.
6.9.1 Name the raw materials and chemical reaction for the manufacture of Butadiene.
6.9.2 Give process description, Flow diagram and uses.

7. PETROCHEMICALS FROM PROPYLENE AND HIGHER OLEFINES
7.1 Describe the manufacturing of Isopropyl alcohol.
7.1.1 Name the raw materials and chemical reaction for the manufacture of Isopropyl alcohol.
7.1.2 Give process description, Flow diagram and uses.

7.2 Describe the manufacturing of Acetone.
7.2.1 Name the raw materials and chemical reaction for the manufacture of Acetone.
7.2.2 Give process description, Flow diagram and uses.

7.3 Describe the manufacturing of Propylene Oxide.
7.3.1 Name the raw materials and chemical reaction for the manufacture of Propylene Oxide.
7.3.2 Give process description, Flow diagram and uses.

7.4 Describe the manufacturing of Propylene Glycol.
7.4.1 Name the raw materials and chemical reaction for the manufacture of Propylene Glycol.
7.4.2 Give process description, Flow diagram and uses.

7.5 Describe the manufacturing of Heptenes.
7.5.1 Name the raw materials and chemical reaction for the manufacture of Heptenes.
7.5.2 Give process description, Flow diagram and uses.

7.6 Describe the manufacturing of Acrylonitrile.
7.6.1 Name the raw materials and chemical reaction for the manufacture of Acrylonitrile.
7.6.2 Give process description, Flow diagram and uses.

8. PETROCHEMICALS FROM BTX
8.1 Describe the Sources of Benzene. Also name the Petrochemicals derived from Benzene.

8.2 Describe the manufacturing of Cyclohexane.
8.2.1 Name the raw materials and chemical reaction for the manufacture of Cyclohexane.
8.2.2 Give process description, Flow diagram and uses.

8.3 Describe the manufacturing of Ethylbenzene.
8.3.1 Name the raw materials and chemical reaction for the manufacture of Ethylbenzene.
8.3.2 Give process description, Flow diagram and uses.

8.4 Describe the manufacturing of Styrene.
8.4.1 Name the raw materials and chemical reaction for the manufacture of Styrene.
8.4.2 Give process description, Flow diagram and uses.

8.5 Describe the manufacturing of Cumene.
8.5.1 Name the raw materials and chemical reaction for the manufacture of Cumene.
8.5.2 Give process description, Flow diagram and uses.

8.6 Describe the manufacturing of Nitrobenzene.
8.6.1 Name the raw materials and chemical reaction for the manufacture of Nitrobenzene.
8.6.2 Give process description, Flow diagram and uses.

8.7 Describe the manufacturing of Chlorobenzene.
8.7.1 Name the raw materials and chemical reaction for the manufacture of Chlorobenzene.
8.7.2 Give process description, Flow diagram and uses.

8.8 Describe the Sources of Toluene.
8.9 Describe the manufacturing of Benzene.
8.9.1 Name the raw materials and chemical reaction for the manufacture of Benzene.
8.9.2 Give process description, Flow diagram and uses.

8.10 Describe the manufacturing of Benzene and xylene.
8.10.1 Name the raw materials and chemical reaction for the manufacture of Benzene and xylene.
8.10.2 Give process description, Flow diagram and uses.

8.11 Describe the manufacturing of Phenol.
8.11.1 Name the raw materials and chemical reaction for the manufacture of Phenol.
8.11.2 Give process description, Flow diagram and uses.

8.12 Describe the manufacturing of Nitrotoluene.
8.12.1 Name the raw materials and chemical reaction for the manufacture of Nitrotoluene.
8.12.2 Give process description, Flow diagram and uses.

8.13 Describe the manufacturing of Benzaldehyde.
8.13.1 Name the raw materials and chemical reaction for the manufacture of Benzaldehyde.
8.13.2 Give process description, Flow diagram and uses.

8.14 Describe the manufacturing of Teraphthalic Acid.
8.14.1 Name the raw materials and chemical reaction for the manufacture of Teraphthalic Acid.

8.15 Describe the manufacturing of Diethyl Terephthalate.
8.15.1 Name the raw materials and chemical reaction for the manufacture of Diethyl Terephthalate.
8.15.2 Give process description, Flow diagram and uses.
إسلاميات/مطالعه باكستان

حصه اول

إسلاميات 311

حصه دوم

مطالعه باكستان

کل وقت 20 کلمه

1. قرآن میں سورة آیه المجرمین و سورة طریب آپ یہیں آیت آپ از عہد الرسول ﷺ آنے والا ہے صافائیت کی

2. قرآن میں سورة طریب آپ یہیں آیت آپ از عہد الرسول ﷺ آنے والا ہے صافائیت کی

1. بسی اسلام ایک حکم شہادت ان لاہ ائلہ و اقامۃ الصلاہ و ایتے

2. اذان و بحث بہت و صوم رمضان

3. الدین المصیحہ

4. المستشار الموتی

للہومن سے خصائص جو بیودیا ا المسلم و بیکار ہے اذاب اذاب

5. و بیگزہ اذآذاع و بیلہ اذآذاع و بیکار ہے

6. اذاع اذآذاع لا تکن من خانک

7. لی باخج الحج فاطم

8. ان العبد حرم علیكم فتوق الامبات و اضعا عطا

9. بیسرا و لا تعسرا باشا و لا نظرنا

10. ذاع طمع الامبات من رضی با للہ و بالسلام دینا و بسحدبیا

11. افضل الگلکر لا لله الا للہ

12. میری ترقب

3. ضریف فراغ

4. واضع آتے بیونہ فراغ

5. اسلام کا غلط فراغ

6.نیا فراغ
نصاب اخلاقیات (فرم taxonomy کے لئے)
سال میں
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1
ناپت 20 گھنٹے

موضوعات
- اخلاقیات
- بنیادی
- عامل
- نمایش
- قانون کے محمد کے
- چارہ
- عالم آمید
- خوشگی
- عفو
- گری
- نور
- اخلاقیات
- جامع
- بنیادی
- م干涉یات (صدر اعظم خرڅا، مانا، دام، اخلاقیات، عافیہ)
حقوق و فردیت

حقوق و فردیت اسلامی معاشرت کا اہم اہمیت کے حامل ہیں۔

خصوصی مقامی کے

افادہ کی درجہ بندی کے

افادہ کی اہمیت کے

معاشرت ور افراد کے زندگی میں امامت سے اہمیت کے

حقوق و فردیت اسلامی معاشرت کا اہم اہمیت کے

اخلاقیت اسلام

اخلاقیت اسلام کا مقدمہ اسلامی مقامی کے اخلاقیت سے متعلق ہے۔

خصوصی مقامی

اخلاقیت اسلام کا مقدمہ اسلامی مقامی کے اخلاقیت سے متعلق ہے۔

خصوصی مقامی

اخلاقیت اسلام کا مقدمہ اسلامی مقامی کے اخلاقیت سے متعلق ہے۔

خصوصی مقامی

اخلاقیت اسلام کا مقدمہ اسلامی مقامی کے اخلاقیت سے متعلق ہے۔

خصوصی مقامی

اخلاقیت اسلام کا مقدمہ اسلامی مقامی کے اخلاقیت سے متعلق ہے۔

خصوصی مقامی
AIMS The study of this subject will enable the student to develop the management skill, acquaint him with the principles of management and human relations and develop psychological approach to solve the labor problems.

**Course Contents:**

1. Industrial Psychology 2 Hrs
2. Industrial Management 2 Hrs
3. Planning 3 Hrs
4. Resource Management 2 Hrs
5. Industrial Fatigue and Boredom 2 Hrs
6. Industrial Prejudice 2 Hrs
7. Human Relations 3 Hrs
8. Job Evaluation 3 Hrs
9. Leadership 2 Hrs
10. Motivation 2 Hrs
11. Guidance and Counseling 2 Hrs
12. Working Conditions 2 Hrs
13. Budget as Controlling Technique 3 Hrs
14. Role of foreman in Management 2 Hrs

**Detail of Contents:**

1. Industrial Psychology 2 Hrs
   1.1 History and definition
   1.2 Application and Importance
2. Industrial Management 2 Hrs
   2.1 Introduction
2.2 Functions of management
2.3 Subdivisions of management
2.4 Objectives of industrial management.
2.5 General principles of management

3. Planning 3Hrs
3.1 Definition
3.2 Steps of Planning
3.3 Advantages

4. Human Resource Management 2 Hrs
4.1 Recruitment and orientation of employees
4.2 Training
4.3 Effects of training on production and product cost

5. Industrial Fatigue and Boredom 2 Hrs
5.1 Definition and distinction
5.2 Psychological causes
5.3 Objective causes
5.4 Prevention

6. Industrial Prejudice 2 Hrs
6.1 Causes and Effects
6.2 Remedies

7. Human Relations 3 Hrs
7.1 Importance and Roles
7.2 Functions

8. Job Evaluation 3 Hrs
8.1 Importance
8.2 Job description and specification
8.3 Performance evaluation and job satisfaction
8.4 Work simplification

9. Leadership 2Hrs
9.1 Definition and types
9.2 Qualities of a good leader

10. Motivation 2 Hrs
10.1 Definition
10.2 Types
10.3 Conflict of motives
10.4 Effects of motivation on morale

11. Guidance and Counseling 2 Hrs
11.1 Importance
11.2 Choice of job
11.3 During service

12. Working Conditions 2 Hrs
12.1 Importance and consideration
12.2 Effects on efficiency and per unit cost

13. Budget as Controlling Technique 3Hrs
13.1 Definition
13.2 Types
13.3 Importance
14. Role of Foreman in Management
   14.1 Foreman's abilities
   14.2 Duties and functions

Recommended Textbooks:

1. Industrial Psychology by C.S. Meyers (Publisher: Oxford University Press, London)
2. Psychology of Industrial Behaviors by Smith Wakley (Publisher: Mc-Graw Hill, New York)
3. The Process of Management by Andrew R. Megill (Publisher: William M New Man)
4. Management of Industrial Enterprises by Richard N Omen
IMH-311 INDUSTRIAL MANAGEMENT AND HUMAN RELATIONS

Instructional Objectives:

At the completion of this course, the students will be able to:

1. **Know Industrial Psychology**
   1.1 Describe brief history of industrial psychology
   1.2 Describe in detail definition of industrial psychology
   1.3 State application and important of industrial psychology

2. **Understand Industrial Management**
   2.1 Define management
   2.2 State functions of management
   2.3 Enlist subdivision of management
   2.4 Explain objectives of industrial management
   2.5 Explain general principles of management

3. **Understand Planning**
   3.1 Define planning
   3.2 Describe step of planning
   3.3 Describe advantages of planning

4. **Understand Human Resource Management**
   4.1 Describe the recruitment procedure of employees in an industrial concern
   4.2 Explain training
   4.3 Identify the kinds of training
   4.4 Explain the effects of training on production and product cost

5. **Understand Industrial Fatigue and Boredom**
   5.1 Define fatigue and boredom
   5.2 Describe psychological causes of fatigue and boredom
   5.3 Describe objective causes of fatigue and boredom
   5.4 Explain measures to prevent fatigue and boredom

6. **Understand Industrial Prejudice**
   6.1 Define prejudice
   6.2 Explain causes and effects of industrial prejudice
   6.3 Explain remedies of industrial prejudice

7. **Understand the Human Relations**
   7.1 Explain importance and role of public/human relations
   7.2 Explain functions of public/human relations
8. Understand Job Evaluation
8.1 Explain importance of job evaluation
8.2 Explain job description and job specification
8.3 Explain performance evaluation and job satisfaction
8.4 Explain work simplification

9. Know Leadership
9.1 Define leadership
9.2 Describe types of leadership
9.3 State qualities of a good leader

10. Understand Motivation
10.1 Define motivation
10.2 Describe financial and non-financial motives
10.3 Explain conflict of motives
10.4 Explain effects of motivation on moral

11. Understand the Need for Guidance and Counseling
11.1 State importance of guidance and counseling
11.2 Explain the role of guidance and counseling in choosing the job
11.3 Describe help of guidance and counseling during service

12. Understand the Effects of Working Conditions on Efficiency
12.1 Explain importance of working conditions
12.2 Describe air-conditioning, ventilation, lighting and noise
12.3 State the effects of good working conditions on efficiency and per unit cost

13. Understand Budget as Controlling Techniques
13.1 Explain budget as controlling techniques
13.2 Explain types of budgets
13.3 Explain the importance of budget as controlling technique

14. Understand the Role of foreman in Management
14.1 Explain abilities of a foreman
14.2 Enlist duties of foreman
14.3 Describe functions of foreman as middle management
PETROLEUM REFINING AND GAS PROCESSING

Total Contact Hours

<table>
<thead>
<tr>
<th>Theory: 64 Hrs</th>
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<tbody>
<tr>
<td>Practical: 192 Hrs</td>
<td>2</td>
<td>6</td>
<td>4</td>
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Pre-requisites: None

Course Objectives:
1. To help the students in understanding the refining processes.
2. To acquaint the students with the refinery.
3. To help understand the products obtained from crude petroleum and their testing procedures.
4. To impart the knowledge of refining units and equipments.

Detail Course Contents:

1. Introduction To Petroleum Refining 02 Hours

   1.1 Importance of Petroleum Products
   1.2 Chronology of Petroleum Refining.
   1.3 OPEC and its Production.
   1.4 Types of Refineries.
   1.5 Refineries in Pakistan and their production.
   1.6 Pakistan’s total need of petroleum products.

2. Refinery Processes 02 Hours
   a. Define the following.
      i. Separation Processes.
         1. Distillation.  
         ii) Fractionation.
         iii) Absorption.  
         Iv) Adsorption.
         v) Filtration.
      ii. Reforming Processes.
         1. Reforming.  
         ii) Cracking.
         iii) Hydro- cracking.  
         Iv) Hydrogenation.
         iv) Polymerization.  
         Vi) Alkylation.
         vi) Isomerization.  
         Vi) Aromatization.
         ix) Desulphurization or Sweetening.

3. Distillation 06 Hours

   3.1 Introduction.
3.2 Pretreatment.
3.3 Atmospheric Pressure and Reduced Pressure Distillation.
3.4 Equipment.
3.5 Other Processes.

4. **Thermal and Catalytic Cracking**  
4.1 Introduction to Thermal Cracking.
4.2 Commercial Processes.
4.3 Options for Heavy Feed stocks.
4.4 Introduction to Catalytic Cracking.
4.5 Commercial Processes.
4.6 Options for Heavy Feed stocks.

5. **Product Improvement and Treating**  
5.1 Introduction
5.2 Reforming
5.3 Isomerization
5.4 Alkylation
5.5 Polymerization
5.6 Treating Processes
5.7 Describe Desulfurization processes.

6. **Gas Processing**  
6.1 Introduction
6.2 Gas Streams
6.3 Gas Cleaning
6.4 Water Removal
6.5 Liquid Removal
6.6 Nitrogen Removal
6.7 Acid Gas Removal
6.8 Enrichment
6.9 Fractionation
6.10 Claus Process

7. **CNG Plant**  
7.1 Give introduction to CNG & LPG
7.2 State Characteristics and Comparison of CNG with other Fuels.
7.3 Describe a CNG Filling Station.
7.4 Understand CNG Cylinders for vehicles and their Safety standards.

8. **Petroleum Products**  
8.1 Introduction
8.2 Gaseous Fuels
8.3 Naphtha
8.4 Gasoline
8.5 Kerosene
8.6 Fuel Oil
8.7 Lubricating Oil
8.8 Other Oil Products
8.9 Grease
8.10 Wax
8.11 Asphalt
8.12 Coke
8.13 Sulfonic Acids
8.14 Acid Sludge
8.15 Product Blending

9. Petroleum Product Testing 06 Hours
9.1 Heating Value
9.2 Volatility
9.3 Gravity
9.4 Viscosity
9.5 Flash and Fire Point
9.6 Cloud and Pour Point
9.7 Reid Vapor Pressure
9.8 Conradson Carbon Residue
9.9 Water and Sediment
9.10 Gum Content
9.11 Corrosion test
9.12 Ash
9.13 Sulfur
9.14 Octane Number
9.15 Cetane Number.
9.16 Aniline Point.
9.17 Drop Melting Point of Wax.

10. Storage Tanks 04 Hours
10.1 Understand tankage of petroleum.
10.2 State importance of safe storage tanks in petroleum industry.
10.3 Name various types of tanks used in petroleum industry.
10.4 Describe atmospheric storage tanks.
10.5 Describe High pressure Storage facility.

11. Understand the Corrosion Problems in the Petroleum Field 06 Hours
11.1 Define corrosion.
11.2 State types of Corrosion.
11.3 State the reasons of corrosion in the field of Petroleum.
11.4 State various choices for corrosion protection.
11.5 Describe processing sour crudes.
11.6 Describe low temperature services.
11.7 Describe the use of different metals for refinery chemicals.
11.8 Describe the uses of nonsparking metals and alloy materials in petroleum refining.
11.9 Explain the uses and application neutralizing chemicals in refinery units.

Recommended Textbooks:

**List of Practical:**

1. To determine Specific Gravity and API Gravity (Degrees API) by means of hydrometers. Compute API Gravity from the measurement of Specific Gravity Using API formula and compute it with the measured value of API Gravity.
2. To determine API Gravity of two different gravity liquid fuels at 75°F and Compute its API Gravity at 60°F using the following coefficients of expansion:
   - Up to 35 API = 0.004 per degree.
   - 35 to 50 API = 0.005 per degree.
3. To study the operation of crude distillation of oil with approximate boiling range.
4. Study the working and construction of bubble cap fractionating column.
5. To study the construction and working principle of absorption column.
6. To study the construction and working principle Glycol Contactor of Glycol Dehydration unit.
7. To study the construction and working principle of Thermal Cracking process.
8. To study the construction and working principle of Catalytic Cracking process.
9. To study the construction and working principle of Platforming process.
10. To determine water and Sediment in petroleum fuels by Centrifuge Method.
11. To determine water content of petroleum fuels by standard ASTM method.
12. To determine Sediment in fuel oil by ASTM Extraction method.
13. To determine Pour Point and Cloud Point of different petroleum fuels.
14. To determine Freezing Point of different petroleum fuels.
15. To determine Ash by standard ASTM method.
16. To determine viscosity of a viscous oils at 122°F by Saybolt-Furol Orifice Viscometer.
17. To determine viscosity of a relatively less viscous oil by means of Saybolt Universal Orifice Viscometer at 100°F.
19. To determine Vapor Pressure of fuels by Reid Vapor-Pressure Bomb method.
20. To determine Gum Content of gasoline by Evaporation method.
21. Determination of flash point of petroleum products by Cleveland Open-Cup Apparatus.
22. Determination of fire point of petroleum by Cleveland Open-Cup Apparatus.
23. Determination of aniline point of oil by Aniline Point and Mixed Aniline Point Apparatus.
24. Determination of the Smoke Point of kerosene for use in railway Signal lamps by burning test lamp.
26. Perform con penetration test on lubricating grease by penetrometer.
27. Determination of viscosity of oil at different Temperatures by Redwood viscometer.
29. Perform ASTM distillation test on petroleum products.
31. Determination of breaking point of bitumen by bending apparatus.
32. Determination of diesel index.
33. Determination of initial and final boiling point of petroleum products by ASTM distillation Apparatus.
34. Determination of viscosity index of lube oil.
35. Determination of total salt content of crude by conductivity method.
36. Determination of melting point of grease by Drop Melting point Apparatus.
37. Determination of the softening point of grease by Ball and Ring method.
38. To determine the Carbon Residue by Ramsbottom Carbon Residue Apparatus.
39. To determine the Acid Number of Petroleum Products by Potentiometric Titration.
40. To determine the Oil Content of Wax.
41. To determine the Kinematic Viscosity of Petroleum Products by Kinematic Viscometer.
42. To determine the Calculated Cetane Index of Diesel Fuel.
43. To determine the Water Vapor Content of Gaseous Fuels by Dew Point Tester.
44. To determine the Viscosity Gravity Constant of Diesel Fuel.
45. To practice the Manual Sampling of Petroleum Products.
46. To understand the Construction and Working of Gas Stabilizer.
47. To understand and state the Start-up and Shut-down Procedure and Routine Operator Checks for Stabilizer.
48. To understand and state the Procedure Start-up and Shut-down and Routine Operator Checks for Glycol Dehydration Unit.
49. To understand and state the Procedure for Gas Plant Vessel for Entry, Start-up and Purging.
50. To study the procedure for launching and receiving pipeline scrapper for Oil and gas Transportation via pipeline.
PCT-304 Instructional Objectives:

1. Introduction To Petroleum Refining
   1.1 Importance of Petroleum Products.
   1.2 Chronology of Petroleum Refining.
   1.3 OPEC and its Production.
   1.4 Types of Refineries.
   1.5 Refineries in Pakistan and their production.
   1.6 Pakistan’s total need of petroleum products.

2. Refinery Processes
   2.1 Understand refinery processes.
      2.1.1 Define following Separation Processes.
         i) Distillation.     ii) Fractionation.
         ii) Absorption.     iv) Adsorption.
         v) Filtration.
      2.1.2 Define following Reforming Processes.
         i) Reforming.     ii) Cracking.
         ii) Hydro- cracking.     iv) Hydrogenation.
         iv) Polymerization.     vi) Alkylation.
         iii) Isomerization.     viii) Aromatization.
         x) Desulphurization or Sweetening.

3. Distillation
   3.1 Give introduction to distillation.
   3.2 Describe Pretreatment of crude oil.
      3.2.1 Explain Desalting of crude oil.
   3.3 State Atmospheric Pressure and Reduced Pressure Distillation.
      3.3.1 Explain Atmospheric Pressure Distillation.
      3.3.2 Describe Reduced Pressure Distillation. (Vacuum Distillation)
   3.4 State Equipment used for distillation.
      3.4.1 Describe types of Distillation Columns.
3.4.2 Explain Packing used in Distillation Columns.
3.4.3 Explain different types of Trays.
3.5 State Other Processes used during crude distillation.
  3.5.1 Describe Stripping.
  3.5.2 Explain Rerunning.
  3.5.3 Describe Stabilization and Light-End Removal.
  3.5.4 Describe Super-fractionation.
  3.5.5 Describe Azeotropic Distillation.
  3.5.6 Explain Extractive Distillation.

4. Thermal and Catalytic Cracking
  42.1 Give introduction to Thermal Cracking.
  4.2 Describe Commercial Thermal Cracking Processes
     4.2.1 Explain Visbreaking Process.
     4.2.2 Describe Coking Process.
  4.3 Describe Thermal Cracking Options for Heavy Feed stocks.
  4.4 Give introduction to Catalytic Cracking.
  4.5 Describe Commercial Catalytic Cracking Processes.
     4.5.1 Explain Fixed-Bed Catalytic Cracking Process.
     4.5.2 Describe Fluid-Bed Catalytic Cracking Process.
     4.5.3 Describe Moving-Bed Catalytic Cracking Process.
  4.6 Describe Catalytic Cracking Options for Heavy Feed stocks.
  4.7 Explain Hydro-cracking Process.

5. Product Improvement and Treating
  5.1 Introduction to product improvement processes.
  5.2 State Reforming processes.
     5.2.1 Describe Thermal Reforming.
     5.2.2 Describe following Catalytic Reforming processes.
        5.2.2.1 Explain Fixed-Bed Process.
        5.2.2.2 Explain Moving-Bed Process.
        5.2.2.3 Explain Fluid-Bed Process.
  5.3 Define and explain Isomerization process.
  5.4 Define and explain Alkylation process.
  5.5 Define and explain Polymerization process.
  5.6 Give introduction Treating Processes.
     5.6.1 Describe Caustic Treating Process.
     5.6.3 Explain Acid Treating Process.
     5.6.4 Describe Clay Treating Process.
     5.6.5 Explain Oxidative Treating Process.
     5.6.6 Describe following Solvent Treating Process.
        5.6.6.1 Explain Solvent De-asphalting.
        5.6.6.2 Explain Solvent Refining.
        5.6.6.3 Explain Solvent De-waxing.
  5.7 Describe BTX Extraction process.
  5.8 Describe Desulfurization processes.
     5.8.1 Explain Solvent Desulfurization.
     5.8.2 Describe Hydro- Desulfurization.

6. Gas Processing
  6.1 Give introduction to gas processing.
  6.2 State Gas Streams.
6.2.1 Describe Gas Streams from Crude Oil.
6.2.2 Describe Gas Streams from Natural Gas.

6.3 State Gas Cleaning Processes.
6.3.1 Describe Amine Washing.
6.3.2 Describe Carbonate Washing.
6.3.3 Describe Cyclone Collectors.
6.3.4 Describe Fabric Filters.
6.3.5 Describe Wet Scrubbers.
6.3.6 Describe Electrostatic Precipitators.

6.4 State Water Removal or Dehydration processes.
6.4.1 Describe Absorption or Glycol Dehydration process.
6.4.2 Describe Solid Adsorbents process.
6.4.3 Describe use of Membranes for water removal.

6.5 State Liquid Removal processes.
6.5.1 Describe Extraction process.
6.5.2 Describe Absorption process.
6.5.3 Explain Fractionation of Natural Gas Liquids.

6.6 Describe Nitrogen Removal process.

6.7 State Acid Gas Removal or Sweetening processes.
6.7.1 Describe Iron Sponge Process
6.7.2 Describe Gribotol Process or Ethanolamine process.
6.7.3 Describe Phosphate Desulfurization process.
6.7.4 Describe Molecular Sieves Process.

6.8 Describe Enrichment process.

6.9 Describe Fractionation of gases.

6.10 Describe Claus Process for Production of Elemental Sulfur.

7. CNG Plant
7.1 Give introduction to CNG & LPG
7.2 State Characteristics and Comparison of CNG with other Fuels.
7.3 Describe a CNG Filling Station.
7.3.1 Gas Inlet, oil formation and drainage.
7.3.2 Filter, its construction and purpose.
7.3.3 Compressor and its control.
7.3.4 Cooling Tower and its purpose.
7.3.5 Control Panel.
7.3.5 Maintenance facilities.
7.3.6 Filling and Metering.
7.4 Understand CNG Cylinders for vehicles and their Safety standards.
7.5 Understand LPG Cylinders for vehicles and their Safety standards.

8. Petroleum Products
8.1 Give introduction to Petroleum products.
8.2 Describe Gaseous Fuels.
8.2.1 Give Composition and Describe manufacturing process.
8.2.2 State Properties and Uses.
8.3 Understand Naphtha.
8.3.1 Give Composition and Describe manufacturing process.
8.3.2 State Properties and Uses.
8.4 Understand Gasoline.
8.4.1 Give Composition and Describe manufacturing process.
8.4.2 State Properties and Uses.
8.4.3 Describe Octane Number.
8.4.4 State Additives for Gasoline and their purposes.
8.4.5 State types of Gasoline.
8.5 Understand Kerosene.
8.5.1 Give Composition and Describe manufacturing process.
8.5.2 State Properties and Uses.
8.6 Understand Diesel.
8.6.1 Give Composition and Describe manufacturing process.
8.6.2 State Properties and Uses.
8.6.3 Describe Cetane Number.
8.7 Understand Fuel Oil.
8.7.1 Give Composition and Describe manufacturing process.
8.7.2 State Uses.
8.8 Understand Lubricating Oil.
8.8.1 Give Composition and Describe manufacturing process.
8.8.2 State Properties and Uses.
8.9 Describe Other Oil Products.
8.9.1 Describe White Oil.
8.9.2 Describe Insulating Oil.
8.9.3 Describe Insecticides.
8.10 Understand Grease.
8.10.1 Give Composition and Describe manufacturing process.
8.10.3 State Properties and Uses.
8.10.3.1 Describe Lime Soap Grease.
8.10.3.2 Describe Sodium Soap Grease.
8.10.3.3 Describe Lithium and Barium Soap Grease.
8.10.3.4 Describe Aluminum Soap Grease.
8.10.3.5 Describe Calcium Soap Grease.
8.10.3.6 Describe Cold Sett Grease.
8.11 Understand Wax.
8.11.1 Give Composition and Describe manufacturing process.
8.11.2 State Properties and Uses.
8.12 Understand Asphalt.
8.12.1 Give Composition and Describe manufacturing process.
8.12.2 State Properties and Uses.
8.12.3.1 Describe Road Asphalt.
8.12.3.2 Describe Cutback Asphalt.
8.12.3.3 Asphalt Emulsion.
8.12.3.4 Describe Cold Mix Asphalt.
8.12.3.5 Describe Asphalt Aging.
8.13 Understand Coke.
8.13.1 Give Composition and Describe manufacturing process.
8.13.2 State Properties and Uses.
8.14 Describe Sulfonic Acids.
8.15 Describe Acid Sludge.
8.16 Describe Product Blending.
8.17 Describe methods of transportation of Gaseous and Liquid Petroleum products.

9.1 Define following properties of Petroleum Products. Also give the Apparatus used and the procedure for the determination of these properties.
9.1.1 Heating Value
9.1.2 Volatility
9.1.3 Specific Gravity 9.1.4 API Gravity
9.1.5 Viscosity 9.1.6 Flash and Fire Point
9.1.7 Cloud and Pour Point 9.1.8 Reid Vapor Pressure
9.1.9 Conradson Carbon Residue 9.1.10 Water and Sediment
9.1.11 Gum Content 9.1.12 Corrosion test
9.1.13 Ash 9.1.14 Sulfur
9.1.15 Octane Number 9.1.16 Cetane Number.
9.1.17 Aniline Point 9.1.18 Drop Melting Point of Grease
9.1.19 Breaking Point of Bitumen 9.1.20 Color
9.1.21 Burning properties of Kerosene 9.1.22 Diesel Index
9.1.23 Viscosity Index of Lube Oil 9.1.24 Penetration Index of Grease
9.1.25 Softening Point of Wax

10. Storage Tanks
10.1 Understand tank-age of petroleum.
10.2 State importance of safe storage tanks in petroleum industry.
10.3 Name various types of tanks used in petroleum industry.
10.4 Describe atmospheric storage tanks.
   10.4.1 Describe cone roof tanks.
   10.4.2 Describe dome roof tanks.
   10.4.3 Describe breather roof tanks.
   10.4.4 Describe external floating roof tanks.
   10.4.5 Describe internal floating roof tanks.
   10.4.6 Describe lifter roof tanks.
10.5 Describe High pressure Storage facility.
   10.5.1 Describe spheroids.
   10.5.2 Describe vessels.

11. Understand the Corrosion Problems in the Petroleum Industry
12.1 Define corrosion.
12.2 State types of Corrosion.
   12.2.1 Describe sulfide corrosion.
   12.2.2 Explain acid corrosion.
12.3 State the reasons of corrosion in the field of Petroleum.
   12.3.1 Corrosion during drilling.
   12.3.2 Corrosion at surface production facilities.
   12.3.3 Corrosion in pipeline.
   12.3.4 Corrosion in Refinery.
12.4 State various choices for corrosion protection.
   12.4.1 Use of corrosion resistant metal and alloys.
   12.4.2 Cathodic Protection.
   12.4.3 Anodic Protection.
12.5 Describe processing sour crudes.
12.6 Describe low temperature services.
12.7 Describe the use of different metals for refinery chemicals.
   12.7.1 Name non-sparking metals.
   12.7.2 Name non-sparking alloys.
12.8 Describe the uses of non-sparking metals and alloy materials in petroleum refining.
12.9 Explain the uses and application neutralizing chemicals in refinery units.
PCT-313  INSTRUMENTATION AND ADVANCED CONTROL

Total Contact Hours  
Theory: 64Hrs  
Practical: 96Hrs

Pre-requisites: None

Course Objectives:
1. To teach the principles and mechanisms of various control instruments used in petroleum, petrochemical and chemical industries.
2. To explain the function and working of control instrument used for controlling different process variable in petrochemical & allied industries.
3. To explain the principals and working of different control systems, controllers, control valves and actuators.

Detail Course Contents:

1. INSTRUMENT TYPES AND PERFORMANCE CHARACTERISTICS 2 Hours
   1.1 Importance of instrumentation.
   1.2 Instrument types.
   1.3 Static characteristics of instruments.
   1.4 Dynamic characteristics of instruments
   1.5 Necessity for calibration

2. ERRORS DURING THE MEASUREMENT PROCESS 2 Hours
   2.1 Introduction
   2.2 Sources of systematic error
   2.3 Reduction of systematic errors
   2.4 Quantification of systematic errors
   2.5 Random errors
2.6 Aggregation of measurement system errors

3. Temperature Measuring Instruments 10 Hours
   3.1 Different Temperature Scales.
   3.2 Conversion of scales.
   3.3 Bimetallic thermometers.
   3.4 Bimetallic thermometers construction.
   3.5 Types of bimetallic thermometers construction
   3.6 Spiral bimetallic thermometers.
   3.7 Helical bimetallic thermometers
   3.8 Liquid-in-glass thermometer construction.
   3.9 Types of liquids filled thermometers
   3.10 Filled system thermometer construction.
   3.11 Thermocouples.
   3.12 Resistance thermometers.
   3.13 Pyrometers Optical, Radiation.

4. Pressure Measuring Instruments 10 Hours
   4.1 Units of pressure.
   4.2 Calculating pressure.
   4.3 Inferred pressure
   4.4 U-tube manometer.
   4.5 Inclined tube manometer.
   4.6 Well type manometer.
   4.7 Inverted bell type manometer.
   4.8 Bourdon tube pressure gauges.
   4.9 Types of Burden tube construction.
   4.10 C-shaped Burden tubes.
   4.11 Spiral Bourdon tubes.
   4.12 Helical Bourdon tubes.
   4.13 The Pirani gauges.
   4.14 Diaphragm pressure sensors.
   4.15 Diaphragm construction.
   4.16 Single diaphragm.
   4.17 Capsule diaphragm.
   4.18 Capsule stack.
   4.19 Bellows pressure sensors.

5. Flow Measurement 10 Hours
   5.1 Displacement Meters.
   5.2 Differential flow measurement.
   5.3 Differential pressure measurement.
   5.4 Flow meters.
   5.5 Venturimeter.
   5.6 Orifice meter.
   5.7 Flow nozzles.
   5.8 Rotameter.
   5.9 Turbine meters.
   5.10 Magnetic Meters.
   5.11 Thermal meters.
   5.12 Pitot tube.

6. Liquid Level Measuring Instrument 8 Hours
   6.1 Methods of measuring level.
   6.2 Point Gauge.
6.3 Dip Gauge.
6.4 Sight Glass.
6.5 Storage Tank Gauge.
6.6 Inferred Pressure.
6.7 Bubbler (Purge) Method.
6.8 Ultrasonic Method.
6.9 Electrical Methods.

7. **Understand Control Systems** 12 Hours
   7.1 Enlist Fundamental objectives of process control.
   7.2 Define the process control terms.
   7.3 Understand Feedback and Feed-forward control.
   7.4 Explain control loops with its working principle and its elements.
   7.5 State control strategies.
   7.6 State Multiple Loop Control.

8. **Understand Control Valves, Actuators and Safety Devices** 10 Hours
   8.1 Define control valve.
   8.2 State functions of control valve.
   8.3 Give types of control valves.
   8.4 Define an Actuator.
   8.5 State functions of an Actuator.
   8.6 Describe types of Actuators.
   8.7 Define a Positioner.
   8.9 Describe types of Positioners.
   8.10 State Automatic control switches.
   8.11 Describe safety Devices and Equipments.
   8.12 State advanced control strategies.

**Recommended Textbooks:**

List of Practical: 96 Hours

1. Determine the measurement of pressure by means of a U tube manometer.
2. Take pressure reading at the bottom of a water column by means of a U-tube manometer and a Bourdon Gauge and compare the reading of both instruments.
3. Determine pressure measurement by means of a manometer in inches of Hg. Convert this measurement to inches of H_2O and PSig.
4. Determine water pressure by means of a Bourdon Gauge.
5. Determine gas pressure by means of a Bourdon Gauge.
6. Determine pressure of an oil column being exerted at the bottom of the column.
7. Determine pressure of water column being exerted at the bottom of the column.
8. Determine difference of pressure between two points in a water flow line.
9. Determine specific gravity of oil in a column by measuring column pressure and height of column above the pressure measuring point.
10. Determine gauge pressure of water in flow line and calculate absolute pressure.
11. Determine atmospheric pressure by means of barometer.
12. Determine atmospheric pressure in 1b/in2 and determine the height of atmospheric air column by using the density of air.
13. Practice measurement of temperature of hot water
    i) On Celsius Scale of a mercury Thermometer.
    ii) On Fahrenheit Scale of a mercury thermomter. And compare both readings by converting them.
15. Practice measurement of temperature by means of a thermocouple.
16. Practice measurement of temperature by means of RTD.
17. Compare the readings of bimetallic thermometer, thermocouple and RTD.
18. Determine pressure of a water column and calculate the level of water by using the Density of water.
PCT-313 Instructional Objectives:

1. Introduction

1.1 Importance of instrumentation.

1.2 Instrument types.
   1.2.1 Active and passive instruments.
   1.2.2 Null-type and deflection-type instruments.
   1.2.3 Analogue and digital instruments.
   1.2.4 Indicating instruments and instruments with a signaloutput.
   1.2.5 Smart and non-smart instruments.

1.3 Static and Dynamic characteristics of instruments.
   I) Accuracy and inaccuracy
   ii) Precision
   iii) Repeatability
   iv) Reproducibility
   v) Tolerance
   vi) Range
   vii) Span
   viii) Linearity
   ix) Sensitivity of measurement
   x) Threshold
   xi) Resolution
   xii) Sensitivity to disturbance
   xiii) Hysteresis effects
   xiv) Fidelity
   xv) Response time
   xvi) Stability
   xvii) Dead space

1.4 Necessity for calibration
2. ERRORS AND CALIBRATION
   2.1 Introduction
   2.2 Sources of systematic error
      2.2.1 System disturbance due to measurement
      2.2.2 Errors due to environmental inputs
      2.2.3 Wear in instrument components
      2.2.4 Connecting leads
   2.3 Reduction of systematic errors
      2.3.1 Careful instrument design
      2.3.2 Method of opposing inputs
      2.3.3 High-gain feedback
      2.3.4 Calibration
      2.3.5 Manual correction of output reading
      2.3.6 Intelligent instruments
   2.4 Quantification of systematic errors
   2.5 Random errors
      2.5.1 Statistical analysis of measurements subject to random errors
      2.5.2 Graphical data analysis techniques – frequency distributions
   2.6 Aggregation of measurement system errors
      2.6.1 Combined effect of systematic and random errors
      2.6.2 Aggregation of errors from separate measurement system components
      2.6.3 Total error when combining multiple measurements.
      2.6.4 Aggregation of measurement system errors
   2.7 CALIBRATION OF MEASURING SENSORS AND INSTRUMENTS
      2.7.1 Principles of calibration
      2.7.2 Control of calibration environment
      2.7.3 Calibration chain and traceability
      2.7.4 Calibration records

3. Understand Temperature and Temperature Measuring Instruments
   3.1 State types of instruments commonly used in the plant to measure temperature.
   3.2 Define temperature.
   3.3 Distinguish between heat and temperature.
   3.4 State the various temperature scales used in the industry.
      3.4.1 State the range of different temperature scales.
      3.4.2 Convert different temperature scales.
   3.5 State Thermal Expansion Thermometers.
      3.5.1 Explain the principles of bimetallic thermometers.
         3.5.1.1 State types of bimetallic thermometers.
         3.5.1.2 Explain the construction and working principles of spiral bimetallic Thermometer.
      3.5.2 Explain the principles of glass filled thermometers.
         3.5.2.1 Name types of liquids used in the liquid-in-glass type thermometer.
         3.5.2.2 Explain the construction and working principle of glass filled Thermometers.
      3.5.3 Explain the principles of pressure spring thermometers.
         3.5.3.1 State different types of pressure spring thermometers.
         3.5.3.2 Explain the construction and working principle of pressure
spring Thermometers.

3.6 State Electrical Thermometers.

3.6.1 Thermocouple.

3.6.1.1 Define thermocouple.

3.6.1.2 Explain the primer, construction and working of thermocouple.

3.6.1.3 Enlist various types of thermocouples.

3.6.1.4 Identify the use of various thermocouples for different temperature ranges.

3.6.2 Resistance temperature detectors (RTDs).

3.6.2.1 Define resistance thermometer.

3.6.2.2 Explain construction and working of resistance thermometer.

3.6.2.3 Define and explain thermistors.

3.7 State Infrared Thermometers.

3.7.1 Define pyrometer.

3.7.2 Enlist types of pyrometers.

3.7.2.1 Describe the functioning of radiation pyrometer.

3.7.2.2 Describe the functioning of optical pyrometer.

4. Understand Pressure and Pressure Measuring Instruments

4.1 Define pressure.

4.1.1 Explain what the term, pressure, means.

4.1.2 State different units of pressure.

4.1.3 Convert different pressure units.

4.1.4 Explain what the term, Inferred Pressure, means.

4.2 State types of instruments used to measure pressure.

4.3 Enlist various pressure measuring instruments.

4.4 Mechanical pressure instruments.

4.4.1 Manometers.

4.4.1.1 Describe U-tube manometer.

4.4.1.2 Describe inclined tube manometer.

4.4.1.3 Explain Well type manometer.

4.4.1.4 Describe working of Barometer.

4.4.2 Bourdon gauge.

4.4.2.1 Draw a neat sketch of a bourdon gauge and explain the principle of bourdon gauge with the help of this sketch.

4.4.2.2 Explain the principle of a "C" shaped bourdon tube.

4.4.2.3 State common forms of bourdon tubes.

4.4.3 Mechanical Pressure Sensors.

4.4.3.1 State the principal of diaphragm pressure sensor.

4.4.3.2 Explain the working principal of single diaphragm.

4.4.3.3 Explain Capsule Diaphragm.

4.4.3.4 Explain the Capsule Stack.

4.4.3.5 Draw a neat diagram of Bellow Pressure Sensor.

4.4.3.6 Explain how a Bellow Pressure Sensor measures pressure.

4.5 Electrical pressure instruments.

4.5.1 Electrical Transducers.

4.5.1.1 Define Electrical Transducer.

4.5.1.2 Define pressure transmitter.

4.5.1.3 Define pressure switch.

4.5.2 Describe resistance pressure transducer.

4.5.3 Describe capacitance pressure transducer.

4.5.4 Describe linear voltage differential transformer (LVDT).
4.6 Differentiate between mechanical and electrical transducers.
4.7 State advantages of electrical transducers.

5. Understand flow and flow measurement devices

5.1 Describe flow of the fluid.
5.2 Name type of flow.
5.3 Enlist flow measuring instruments.
5.4 State mechanical flow meters.
   5.4.1 Differential pressure flow meters.
      5.4.1.1 Describe orifice meter.
      5.4.1.2 Explain venturimeter.
      5.4.1.3 Explain flow nozzle.
      5.4.1.4 Explain Pitot tube.
   5.4.2 Variable area meters.
      5.4.2.1 Explain Rotameters.
5.5 Differentiate between:
   5.5.1 Orifice meter & Venturimeter.
   5.5.2 Rotameters & Pitot tube.
5.6 Explain magnetic flow meter.
5.7 State how a positive displacement meter is used to measure flow rate.
5.8 Explain the difference between displacement and inferential flow measurement.
5.9 State the names of two common types of chart recorders used to record flow.

6. Understand Liquid Level and Level Measuring Instruments

6.1 Explain the terms ‘direct measurement’ and ‘indirect measurement related to level measurement.’
6.2 State common methods used in the plants to measure liquid level.
6.3 Mechanical level instruments.
   6.3.1 Visual Inspection.
      6.3.1.1 Explain point gauge.
      6.3.1.2 Describe dip gauge.
      6.3.1.3 Explain sight glass.
      6.3.1.4 Explain armored sight glass.
      6.3.1.5 Explain reflex sight glass.
      6.3.1.6 Explain cable and weight system.
   6.3.2 Explain how pressure is used to indicate liquid level.
      6.3.2.1 Hydrostatic pressure instruments.
      6.3.2.2 Open tank pressure instrument.
      6.3.2.3 Closed tank pressure instrument.
      6.3.2.4 Explain Bubbler method.
   6.3.3 Floats and Displacers.
      6.3.3.1 Explain Tape Floats.
      6.3.3.2 Describe float and dial instrument.
      6.3.3.3 State how a storage tank gauge or displacer functions.
6.4 Electrical Level Instruments.
   6.4.1 Explain Capacitance Level measurement.
   6.4.2 Describe Conductivity Probe.
   6.4.3 Explain Optical Liquid Level Sensor.
6.5 Describe Ultrasonic Liquid level Sensor.

7. Understand Control System

7.1 Enlist Fundamental objectives of process control.
7.2 Define the following.
I) Process control.
   II) Automatic control.
   III) Process variable.
   IV) Control or manipulated variable.
   V) Set Point.
   VI) Primary Element.
   VII) Control Element.
   VIII) Final Element.
   IX) Measuring Element.
   X) Load Change.
   XI) Process Gain.
   XII) Lag.
   XIII) Potential.
   XIV) Dead Time.
   XV) Transmitter

7.3 Understand Feedback and Feedforward control.

7.4 Explain control loops with its working principle and its elements.
   7.4.1 Describe Open Loop Control.
   7.4.2 Describe closed Loop Control.

7.5 State control strategies.
   7.5.1 Explain on-off control.
   7.5.2 Explain proportional control.
   7.5.3 Describe integral control (Reset).
   7.5.4 Describe derivative control (Ratio).
   7.5.5 Describe proportional integral control.
   7.5.6 Describe proportional derivative control.
   7.5.7 Describe integral derivative control.
   7.5.8 Describe proportional integral derivative control.

7.6 State Multiple Loop Control.
   7.6.1 Describe Cascade Control.
   7.6.2 Explain Ratio Control.

8. Understand Control Valves, Actuators and Safety Devices

8.1 Define control valve.
8.2 State functions of control valve.
8.3 Give types of control valves.
   8.3.1 Describe following types of Sliding Stem Valves.
      I) Globe Valve.
      II) Cage Valve.
      III) Split Body Valve.
      IV) Angle Valve.
      V) Y-Style Valve.
      VI) Three Way Valve.
      VII) Diaphragm Valve.
   8.3.2 Explain following types of Rotary Valves.
      8.3.2.1 Butterfly Valve.
      8.3.2.2 Ball Valve.
      8.3.2.3 Plug Valve.

8.4 Define an Actuator.
8.5 State functions of an Actuator.
8.6 Describe following types of Actuators.
   8.6.1 Diaphragm and Spring Actuator.
   8.6.2 Pneumatic Sliding Stem Piston Actuator.
      8.6.3 Pneumatic Rotary Piston Actuator.
      8.6.4 Electric Actuator.
      8.6.5 Spring Return Solenoid Actuator.
      8.6.6 Double Acting Solenoid Actuator.

8.7 Define a Positioner.
8.8 Describe following types of Positioners.
   8.9.1 Linear Actuator Positioner.
   8.9.2 Rotary Actuator Positioner.
8.10 State Automatic control switches.
8.10 Describe mechanical switches.
8.10.2 Explain electrical switches.
8.10.3 Describe electronic switches.

8.11 Describe safety Devices and Equipments.
8.11.1 Explain following types of valves.
8.11.1.1 Describe safety valves.
8.11.1.2 Describe relief valves.
8.11.1.3 Explain safety relief valve.
8.11.1.4 Describe hazardous material safety relief valve.
8.11.1.5 Describe Excess Flow Valve.
8.11.1.6 Describe Fuel Safety Shutoff Valve.

8.11.2 State Rupture Discs.
8.11.3 Explain following types of Rupture Discs.
8.11.3.1 Conventional Metal Rupture Discs.
8.11.3.2 Reverse Buckling Rupture Disc.
8.11.3.3 Composite Rupture Disc.
8.11.3.4 Graphite Composite Rupture Disc.

8.12 State advanced control strategies.
8.12.1 Artificial Intelligence.
8.12.2 Fuzzy Logic.
8.12.3 Neural Network.

PCT-322 OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT

Total Contact Hours  
Theory: 64 Hrs  
Practical: 0 Hrs

Pre-requisites: None

AIMS: At the end of this course, the students will be able to:-
1. Adopt safety standards, codes, rules, etc., to be desired in Workshops, Labs. And Industries.
2. Understand methods of prevention of accident.
3. Provide first aid and rescue in case of any accident.
4. The fundamental knowledge of air pollution control, solid waste management, water pollution control, and noise pollution control.
5. Specific problems of environmental pollution at the petroleum fields and Refineries.

Course Contents:
Part-1= Safety Practice and Procedure

1. Introduction and Importance of Safety
   1.1 Introduction to safety and Housekeeping.
   1.2 Importance in Institute workshops /labs.
   1.3 Importance in industry.
   1.4 Accident cost.
   1.5 OHSA Safety Standards.

2. Accidents in Petroleum Industry
   2.1 Introduction.
   2.2 Flammability limits of hydrocarbons.
   2.3 Preparation limits of hydrocarbons for maintenance.
   2.4 Safety factors in process equipment.
   2.5 Electricity.

3. Accidents in Mechanical Industry
   3.1 Accidents due to material handling and transportation.
   3.2 Accidents due to hand tools.
   3.3 Accidents in machines shop.
   3.4 Accidents in Metal workshop.
   3.5 Accidents in wood working shop.
   3.6 Accidents in foundry, welding and forging shop.
   3.7 Safety in CNC machines operation.

4. Accidents in Chemical and Petrochemical Industries
   4.1 Accidents in textile mills, paper mills & food Industries.
   4.2 Accidents in paint and fertilizer industry.
   4.3 Accidents in Petrochemical Industry.

5. Accidents in other Industries
   5.1 Accidents in mines.
   5.2 Accidents in leather industries.
   5.3 Accidents in power plant (Steam).

6. Electric shocks & Earthling (Prevention and its remedy)
   6.1 Electricity as danger.
   6.2 Electric shock phenomena.
   6.3 Reasons of electric shock.
   6.4 Prevention of electric shock.
   6.5 First aid in electric shock.

7. Fire accidents and their prevention
   7.1 Fire accidents and their prevention.
   7.2 Fire hazard and their types.
   7.2.1 Causes of fire hazard.
   7.3 Fire fighting equipments, and fire extinguishers.
   7.4 Plant lay out for fire safety.

8. Safety in plant Lay-out
   8.1 Safety in Plant lay out.
   8.2 Housekeeping for safety.
   8.3 Safety instruction during maintenance.
   8.4 Safety instruction in use of electricity.

9. Personal Protective Equipment
9.1 Useful protective device.
9.2 Personal protective device and its importance.
9.3 For protection from chemicals and gases.

10. First Aid 2 Hrs
   10.1 Importance.
   10.2 Procedure and training.
   10.3 Extended medical services.

11. Analyzing Causes of Accidents 3 Hrs
   10.1 Accident prevention fundamentals.
   10.2 Plant inspections and accidents investigation.
   10.3 Safety inventory, auditing, records and annual reports.

12. Promoting Safety Culture 2 Hrs
   12.1 Employees training culture.
   12.2 Displays.
   12.3 Guidance.

13. Safety Regulations & adherence to International Safety Standards 2Hrs
   13.1 Safety Regulations & adherence to International Safety Standards.
   13.2 Pakistan Factory Act (laws concerning to safety).
   13.3 Workman compensation act.
   13.4 Industrial insurance and social security.
   13.5 Legal aspects of safety.

Part-2 = Environmental Pollution Control

1. Introduction 02 Hours
   1.1 Define environment.
   1.2 State the Parts or Segments of environment.
   1.3 State the Parts or Regions of Atmosphere.
   1.4 Describe what is meant by “Environmental pollution”.
   1.5 Explain the objectives of environmental pollution control.

2. Air Pollution 09 Hours
   2.1 Composition of air.
   2.2 Sources of air pollution.
   2.3 Local and global effects of air pollution.
   2.4 Indoor air pollution and human health.
   2.5 Air pollution meteorology.
   2.6 Photochemical and industrial smog’s.
   2.7 Pollution Control of suspended particulates, gaseous pollutants, and motor vehicles exhaust.

3. Solid Waste Management 5 Hours
   3.1 Introduction to SWM.
   3.2 Characteristics of solid wastes.
   3.3 Storage and collection systems.
   3.4 Transfer station and processing techniques.
   3.5 Disposal methods.

4. Water Pollution Control 5 Hours
   4.1 Water borne diseases and remedial measures.
   4.2 WHO drinking water standards and their significance.
   4.3 Water pollutants and their sources.
4.4 Water supply systems.
4.5 Sewage and sewerage systems.
4.6 Waste water treatment methods.

5. **Noise Pollution Control** 1 Horus
   5.1 Health implication.
   5.2 Remedial measures.

6. **Environment Pollution Control Laws and Regulation** 1 Hours
   6.1 National Environment Quality Standards (NEQS) for Gaseous and Liquid Wastes.
   6.2 Ambient Air Quality standards.

7. **Land Resources and Conservation** 2 Hours
   7.1 Introduction to land resources.
   7.2 Conservation methods.

8. **Hazardous Waste Management** 2 Hours
   8.1 Industrial waste.
   8.2 Management options.

9. **Environment Pollution Control at Petroleum Fields and Refineries** 5 Hours
   9.1 Specific problem of oil and gas field.
   9.2 Environment pollution control at oil gas field, and refineries.
   9.3 Renewable energy and conservation.
   9.5 Environment implications of mining.

**Recommended Textbooks:**

PCT-322 Instructional Objectives:

Part-1 = Safety Practice and Procedure

1. Know importance of safety practices and its necessity in the industry
   1.1 Describe importance of housekeeping, Safety and accidents.
   1.2 Describe the importance of safety practices in Institute shops/labs.
   1.3 Describe the hazards for not observing safety.
   1.4 State necessity/importance of observing safety in the industry at the Cost of accident.
   1.5 Understand OSHA Field Safety and Health Standards.

2. Know causes and preventions of accident in Petroleum industry
   2.1 Enlist important components that a safety attitude should include.
   2.2 Enlist basic components of fire in an oil field.
   2.3 Describe flammability limits and ignition temperature of hydrocarbon. Clarify the concept with the help of an operational example.
   2.4 List the important actions necessary to make the oil plant equipment ‘safe to Work’ for maintenance purposes.
   2.5 Describe safety factors that are built into all field equipment to prevent failure.

3. Know causes and prevention of accidents in mechanical industry
   3.1 List of accidents in material handling and transportation in industry.
      3.1.1 Describe the methods of prevention of accident due to material and
machine handling in manufacturing Industry.

3.2 Explain proper use of hand tools to prevent accident.
3.3 Describe accidents in machines shop.
3.4 Describe accidents in Metal workshop.
3.5 Describe accidents in wood working shop.
3.6 Describe accidents in foundry, welding and forging shop.
3.7 Describe Safety in CNC machines operation.

4. Know causes and methods of prevention of accident in Chemical industries
4.1 State the types of accident in Chemical process industry.
   4.1.1 List the accident in textile mills, paper and board mills and food industry.
   4.1.2 List the accident in fertilizer, paint and other chemical based industry.
   4.1.3 List the accident in Petrochemical Industries.
   4.1.4 Describe the methods of prevention of accidents in above listed industries.

5. Describe accidents and their remedy in other industries
5.1 Describe accidents in Mines.
5.2 Describe accidents in Leather industries.
5.3 Describe accidents in Power plant (Steam).
5.4 Describe the methods of prevention of accidents in above listed industries.

6. Electric shocks & Earthling (Prevention and its remedy)
6.1 Describe Electricity as danger.
6.2 Describe Electric shock phenomena.
6.3 Describe Reasons of electric shock.
6.4 Describe Prevention of electric shock.
6.5 Describe First aid in electric shock.

7. Fire Accidents and their prevention
7.1 Describe prevention of fire accidents on plant.
7.2 Know the causes of fire hazard.
   7.2.1 Identify fire hazard and their types.
   7.2.2 Describe the fire fighting methods for different types of fires.
   7.2.3 List the causes of accidents due to fire.
7.3 Know Steps to control fire/fire fighting.
   7.3.1 Training of fire fighting with the help of Rescue 1122.
   7.3.2 Know the types of fire extinguishers and their use.
7.4 Identify the fire safety points in plant layout.

8. Know the basic concept of safety in plant layout
8.1 Identify the safety aspect in plant layout.
8.2 Describe the house keeping procedure for safety.
8.3 Identify the procedure to lay out machines and equipments by considering safety aspect.
8.4 Explain the instructions for use of electricity.

9. Know principle method and importance of personal protective device
9.1 State useful protective devices.
9.2 List personal protective devices and describe their importance.
   9.2.1 Describe protection devices protecting Hand, faces, Ear, Leg, Foot and Eyes.
   9.2.2 Describe protection.
   9.2.3 Describe personal safety equipment.
9.2.4 Describe lather safety belt, fire ropes, chain, slings and other supports for precautions.

9.3 Describe use of protection devices for protecting from chemicals and gases.

10. **Know the methods of providing first aid**

   10.1 Identify the importance of first aid.
   10.2 Explain the methods of providing fist aid and their training may be arranged to train the students in first aid procedure (a video).
   10.3 Identify the step by step procedure of providing medical services.
   10.3.1 Describe protection of respiration system and methods of artificial respiration.

11. **Analyzing the causes of accidents**

   11.1 Understand the procedure of analyzing the causes of accidents.
   11.1.1 Identify the general causes of accident.
   11.1.2 Explain step by step procedure to analyze the accidents.
   11.2 Know the use of data for investigation and resident reports for analyzing the causes of accident.
   11.2.1 Record safety inventory, accident report and investigation reports, annual reports.
   11.2.2 Collect the data of accident for analyzing the root of accidents.
   11.3 Identify safety rules procedures in the light of annual accidents report for safe guard.

12. **Understand the methods and procedures for promoting safety culture**

   12.1 Identify the importance of safety.
   12.2 Describe methods of promoting safety concept by display charts, play cards, Banners and wall chalking; through guidance.
   12.3 List methods of promoting safety concepts.

13. **Understand Safety Regulations & adherence to International Safety Standards**

   13.1 Explain safety Regulations & adherence to International Safety Standards.
   13.2 Describe clauses of Pakistan Factory Act related to safety.
   13.3 Describe Workman compensation Act.
   13.4 Identify the procedure for industrial insurance and social security.
   13.5 Describe legal procedure in case of serious accidents.

**Part-2 = Environmental Pollution Control**

1. **Introduction to Environmental pollution Control**

   1.1 Define environment.
   1.2 State the Parts or Segments of environment.
   1.2.1 Define Lithosphere.
   1.2.2 Define Biosphere.
   1.2.3 Define Hydrosphere.
   1.2.4 Define Atmosphere.
   1.3 State the Parts or Regions of Atmosphere.
   1.3.1 Describe Troposphere.
   1.3.2 Describe Stratosphere.
   1.3.3 Describe Mesosphere.
   1.3.4 Describe Thermosphere.
   1.4 Describe what is meant by “Environmental pollution”.
   1.4.1 Define the terms:
   i) Pollutant
   ii) Source
1.5 Explain the objectives of environmental pollution control.

2. **Understand Air Pollution**

2.1 Describe ambient air composition.
2.2 Enlist categorically the sources of pollution.
2.3 Briefly explain the following global effects of air pollution and their Consequences.
   i) Acid Rain.
   ii) Greenhouse Effect.
   iii) Ozone Depletion in the Stratosphere.
2.4 Describe Global Warming and its effects.
2.5 Outline the local effects of air pollution.
   2.5.1 Effects on Materials, Equipments and Buildings.
   2.5.2 Effects on Vegetation.
2.6 Introduction to the effects of air pollution on human health.
2.7 Summarize the sources and health effects of the major air pollutants.
2.8 Explain indoor air pollution.
   2.8.1 Describe the sources and health effects of the following indoor pollutants.
   i) Smoking.
   ii) Radon.
   iii) Asbestos.
   Explain what is meant by “Air Pollution Meteorology”.
2.9.1 Describe the use of wind roses.
2.10 Describe what is meant by “Photochemical Air Pollution”.
   2.10.1 Explain the photochemical smog reactions.
   2.10.2 Describe the effects of photochemical smog.
2.11 Outline the air pollution control methods of the following types of pollutants.
   i) Suspended Particulates.
   ii) Gaseous Pollutants.
   iii) Motor Vehicle Exhaust.

3. **Understand Municipal Solid Waste Management**

3.1 Describe the health impact of solid wastes.
3.2 Outline the classification of solid wastes.
3.3 List the major components of the municipal solid wastes.
3.4 Introduction to Solid Waste Management (SWM)
3.5 Explain the onsite handling and onsite storage of solid wastes.
3.6 Describe the collection systems of solid wastes.
3.7 Define three types of transfer stations used to accomplish removal and Transfer of solid wastes.
3.8 Outline various processing and Recovery techniques used in solid wastes.
3.9 Explain the following methods used for the disposal of solid wastes.
   i) Composting.
   ii) Incineration.
   iii) Sanitary Land filling

4. **Understand Water Pollution Control**

4.1 Introduction to the water borne diseases and remedial measures.
4.2 Outline the WHO drinking water standards and their significance.
4.3 Outline the types of water pollutants and their sources.
4.4 Explain the water supply systems.
4.5 Describe the waste water treatment methods.
   4.5.1 Explain treatment of Sewage Water.
   4.5.2 Explain treatment of Industrial Waste Water.

5. **Understand Noise Pollution Control**

5.1 Introduction to Noise Pollution.
5.2 Explain how noise measurement is made.
5.3 State the sources of Noise.  5.4 Describe health implication of noise.
5.5 Describe how noise pollution can be controlled.

6. **Know the Environmental Pollution Control Laws and Regulations**
6.1 State the Important aspects shortfalls of Pakistan Environmental Ordinance 1983.
6.2 State the Salient Features of Pakistan Environmental Ordinance 1997.
6.3 Outline the National Environmental Quality Standards (NEQS) for gaseous and liquid wastes.
6.4 Outline the National Environmental Quality Standards (NEQS) for Motor Vehicle Exhaust and Noise.

7. **Understand Land Resources and conservation**
7.1 Introduction to land resources.
7.2 Outline the methods for conservation of land resources.

8. **Understand Hazardous waste Management**
8.1 Introduction to Hazardous Waste Management.
8.2 Enlist various hazardous wastes.
8.3 Describe various management options for hazardous waste.

9. **Understand Environmental Pollution Control at Petroleum Fields and Refineries**
9.1 Introduction to environmental pollution at petroleum fields and refineries.
9.2 Discuss specific problems of oil and gas fields regarding environmental pollution.
9.3 Describe methods of environmental pollution control at petroleum fields and refineries.
9.4 Explain renewable energy and conservation.
9.6 Discuss environmental implications of mining.

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**PCT-331 INDUSTRIAL STOICHIOMETRY**

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<th>Total Contact Hours</th>
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<tbody>
<tr>
<td>Theory</td>
<td>32 Hrs</td>
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Pre-requisites: None

Course Objectives:
1. To impart knowledge from basic principles of industrial stoichiometry.
2. To help the student in understanding procedures for stoichiometric calculations of industrial products.

**Detail Course Contents:**

1. **Fundamental Principles of Stoichiometry**  8 Hours
   1.1 Mathematical principles.
   1.2 Fundamental physical laws.

2. **Chemical Equation**  12 Hours
   2.1 Chemical formulas.
   2.2 Chemical equations.
   2.3 Limiting and excess reactants.
   2.4 Degree of completion of a reaction.
   2.5 Limitation of a chemical equation.
   2.6 Numerical problems.

3. **Material Balance & Energy Balance**  12
### Hours

3.1 Classification of Industrial Process
3.2 Concepts of bypass and recycle processes
3.3 Numerical based on material & Energy balances.

### Recommended Textbooks:


### PCT-331 Instructional Objectives:

1. Understand Fundamentals of Mathematical and physical principles used in Stoichiometric Calculations
   1.1 Describe Dimension, Units, Labels, and Conversion Factors with reference to Primary and Secondary quantities.
   1.2 Differentiate between primary Quantities and secondary Quantities.
   1.3 Enlist dimensions, symbols and units of primary & secondary quantities in tabular form.
   1.4 Solve numerical problems involving the use of conversion factors. Himmelblau, chapter 1, Problems 4, 5, 6 and 7 page 21 and Problems 1.1, 1.2, 1.4 page 33.
   1.5 Describe the significance of ‘Ratios’ and ‘Fractions’ in stoichiometric calculations.
   1.6 Differentiate between pound mass and pound force.
   1.7 Define and discuss the following the physical Laws.
      a) Conservation of mass.
      b) Conservation of energy.
      c) Law of combining weights
      d) Ideal gas law.
      e) Avogadro’s law.
      f) Dalton’s law.
      g) Amagat’s law.

2. Understand Fundamental Chemical Principle used in Stoichiometry
   2.1 Define Element, Compound and Chemical Formula.
   2.2 Describe the use of chemical formula in calculating the percentage by weight of each Element in a Compound. Solve relevant numerical problems.
   2.3 Define Atomic Weight, Molecular weight, Chemical formula weight and Mole.
   2.4 Solve numerical problem illustrating the use of chemical formulas. Himmelblau, chapter 2,
Problems 1, 2, 3 page, Problems 1, 2, 3, 4 page 59, Problems 2.8, 2.9, 2.10, 2.11, 2.12, 2.40 page 70. Stoichiometry for Chemical Engineers, Problems 2.1 to 2.9 page 54.

2.5 Describe the main functions of chemical Equations in stoichiometry.

2.6 Enlist the important terms which are useful in calculation based on chemical equations.

2.7 Describe weight-weight and weight-volume calculation based on chemical equations. Solve relevant numerical problems.

2.8 Define each of the following terms.
   a) Limiting Reactant
   b) Excess Reactant
   c) Degree of completion of a reaction
   d) Percent conversion

2.9 Solve relevant numerical problems. Stoichiometry for Chemical Engineers, Problems 2.10 to 2.15 page 55.

2.10 Enlist the limitations of a chemical equation.

3. **Understand Material Balance & Energy Balance**

3.1 Describe material & Energy Balances with equation.

3.2 Give classification of industrial processes with industrial examples.
   ii) ‘Batch’ and ‘Continuous’ Processes.

3.3 Enlist important steps suggested for the solution of problems based on material Balance.

3.4 Describe ‘Key Component’ and its significance in material balance Calculations.

3.5 Indicate two different algebraic approaches of solving material balance Problems.

3.6 Illustrate the use of simultaneous equations in solving material balance Problems.

3.7 Describe the concepts of Bypass and Recycle.

3.8 Solve relevant numerical problems. Stoichiometry for Chemical Engineers,

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**PCT-342 UNIT OPERATIONS**

**Total Contact Hours**

Theoretical: 32 Hrs.  
Practical: 96 Hrs.

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**Pre-requisites:** None

**Course Objectives:** This course is designed to assist the students:

1. To apply Principles of unit operations in the laboratory work.
2. Chemical production equipment related to these operations.

**Detail Course Contents:**

1. **FILTRATION’CLASSIFICATION OF FILTERS** 8 Hours
   1.1 Filter media, filter acids.
   1.2 Sand filter, chamber press.
   1.3 Plate and frame press, leaf filter, pressure filter.
   1.4 Rotary filter.
1.5 Washing of filter cakes.

2. **SIZE REDUCTIONS**  

   2.1 Classifications of crushing and grinding machinery.

   2.2 Jaw crushe.

   2.3 Roll crushe.

   2.4 Single roll crushe.

   2.5 Fine crushe.

   2.6 Roller mills.

   2.7 Ball and tube mill.

   2.8 Ultra fine crushe.

   2.9 Closed circuit crushe.

3. **EXTRACTION**  

   3.1 Extraction, classifications of extraction equipments.

   3.2 Oil seed plant.

   3.3 Continuous diffusion batteries.

   3.4 Dorr agitator, Door thickener.

   3.5 Counter current decantation system.

   3.6 Counter current extraction with filters.

   3.7 Liquid extraction towers.

   3.8 Baffle plate towers, spray towers, pulse towers, agitated operation towers.

   3.9 Centrifugal type extraction.

4. **EVAPORATION & BOILERS**  

   4.1 Basic principal of evaporation.

   4.2 Types of evaporation.

   4.3 Construction and operation of
      1. Short tube evaporation.
      2. Long tube vertical evaporator.

   4.4 Forced circulating up ward flow (climbing film) evaporator.

   4.5 Construction and working of
      1. Falling film evaporator.
      2. Agitated film evaporator.

   4.6 Evaporator accessories.

   4.7 Multiple evaporators.

   4.8 Principle economy and capacity.

   4.9 Effect of boiling point elevation.

   4.10 Methods of feeding.

   4.11 Removal of non-condensed gases.

   4.12 Removal of condensates, salt removal.

   4.13 Boiler and its types with working mechanism and safety

   4.14 **EVAPORATOR PROMBLES**
      4.14.2 Trouble shooting in operation of evaporators, remedies.
Recommended Textbooks:


List of Practical:

1. Introduction to unit operation laboratory.
2. The principles in unit operation should include a considerable amount of installing and dismantling the equipment whichever is feasible.
3. To make Models of different Equipment.
4. To determine overall heat transfer and efficiency of climbing and falling film Evaporator if
   (i) Feed rate is constant.
   (ii) Steam pressure is constant.
5. Study the theory and operation of filter press, filtering, washing, cleaning of press, by filtering various industrially important slurries.
7. Study the operation of a portable mixer by use of various industrially important materials.
8. Determination of horse power required and rate of mixing for the mixing of definite quantities of materials (such as salt and sand) in dry and wet states.
9. Determination of the number of revolutions and time required for mixing of two materials per unit weight and calculation of the efficiency of the mixer.
10. Determination of rate of drying for “u” fibrous and granular material.
11. Study the operation of a sieve shaker through the use of a variety of crushed solids (alternately, manual screen analysis may be carried out).
12. Study the operation of a pulverizer by using a variety of materials analyze efficiency and purpose of the machine y sieve screen analysis.
13. Study the operation of various mills by grinding several ultra analysis of efficiency and purpose of the machines by sieve screen analysis.
14. Study the operation jaw crusher.
15. Determine the horse power required for crushing definite materials e.g. bricks.
16. Determine the horse power required for grinding a definite quantity of material to 100 mesh in a mill. Also calculate the work index for such a grinding operation.
17. Prepare a graph relating particle diameter in simple grinder.
18. To study the stone crushers using Hammer Mill with closed circuit grinding system.
19. Study of different Conveyer belts.
20. Practice extraction of Oils from different seeds using Extractor.

**PCT-342 Instructional Objectives:**

1. **FILTRATION**
   1.1 Understand filtration.
      1.1.1 Define filtration.
      1.1.2 Define and Enlist filter Medias. Also give its properties.
      1.1.3 Define filter aid with examples.
      1.1.4 Describe methods of using filter aid.
   1.2 Understands filters.
      1.2.1 Gives classification of filters.
      1.2.2 Explain construction and working of
         (a) Sand filter.
2. SIZE REDUCTION
2.1 Understand size reduction.
2.1.1 Define size reduction (crushing & grinding.)
2.1.2 Gives classification of crushing & grinding machinery.
2.1.3 Differentiate between intermediate grinding, fine grinding and ultra fine grinding.
2.1.4 Explain construction and working
   a) Jaw crusher.
   b) Hammer Mill.
   c) Roll crushers. (Single and Double Roll)
   d) Ball mill.
   e) Tube mill.
2.1.5 Explain the construction and working of ultrafine grinder.
2.1.6 Explain closed circuit grinding.

3. EXTRACTION
3.1 Understand extraction.
3.1.1 Describe extraction with examples.
3.2 Understand the extraction equipments.
3.2.1 Give the classification of extraction equipment.
3.2.2 Explain the oil seed extraction plant.
3.2.3 Explain the construction and working of
   a) Continuous diffusion batteries.
   b) Dorr agitator.
   c) Dorr Thickener.
3.2.4 Explain counter current decantation system.
3.2.5 Explain counter current extraction with filters.
3.2.6 Explain the construction and working of liquid – liquid extraction towers like
   d) Baffle plate tower.
   e) Spray tower.
   f) Pulse tower.
   g) Agitated extraction tower.
3.2.7 Explain the construction and working of centrifuge type extractor.

4. Evaporation and Boilers
4.1 Define evaporations.
4.1.1 Enlist types of evaporators.
4.1.2 Explain constructions and working of horizontal.
4.1.3 Explain construction and working of short tube evaporator.
4.1.4 Explain construction and working of long tube evaporator.
4.1.5 Explain construction and working of climbing film evaporator.
4.1.6 Explain construction and working of falling film evaporator.
4.2 Understand evaporator accessories.
4.2.1 Define evaporator accessories.
4.2.2 Enlist evaporator accessories.

4.3 Understand multiple effect evaporator.
   4.3.1 Explain basic principle of multiple effect evaporation.
   4.3.2 Explain constructions and working of a triple effect evaporator.
   4.3.3 Enlist the methods of feeding.
   4.3.4 Explain forward feeding method.
   4.3.5 Explain backward feeding method.
   4.3.6 Explain mixed feeding method.
   4.3.7 Explain economy and capacity of a multiple effect evaporator.

4.4 Understand the problems of evaporators.
   4.4.1 Explain the effect of non-condensed gases and their removal.
   4.4.2 Concentration scale formation, its effects and removal.

4.5 Explain trouble shootings in the operations of evaporator and their remedies.

4.6 Boilers for Steam production
   4.6.1 Steam and Its Properties
   4.6.2 Types of Boilers and their working
   4.6.3 Safety in Boilers Operations.

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PCT-352 CHEMICAL PROCESS INDUSTRIES

Total Contact Hours
Theory: 32Hrs
Practical: 96Hrs

Pre-requisites: None

Course Objectives:
1. Understand important manufacturing procedure employed by modern chemical industries.
2. Understand different chemical processes commonly employed in chemical industries.
3. Chemical production equipment related to these processes.
4. Enable the student to draw flow sheet diagram & know about water treatment and analysis.

**Detail Course Contents:**

<table>
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<tr>
<th>1</th>
<th>CEMENT INDUSTRY</th>
<th>5 Hours</th>
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<tbody>
<tr>
<td>1.1</td>
<td>Introduction to Cement.</td>
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<tr>
<td>1.2</td>
<td>Describe preparation, properties and applications of types of Cements.</td>
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<tr>
<td>1.3</td>
<td>Introduction to Portland cement.</td>
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<td>1.4</td>
<td>Explain manufacturing of Portland cement.</td>
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<tr>
<td>1.5</td>
<td>Compare dry and wet processes of Cement manufacturing.</td>
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<td>1.6</td>
<td>Describe settling and hardening of Cement.</td>
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<td>1.7</td>
<td>Describe physical properties of Portland cement.</td>
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<td>1.8</td>
<td>Explain Decay of Cement, its reasons and prevention.</td>
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<td>1.9</td>
<td>Introduction to Lime.</td>
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<td>1.10</td>
<td>Understand Plaster of Paris.</td>
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<tr>
<th>2</th>
<th>SUGAR INDUSTRY</th>
<th>5 Hours</th>
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<tbody>
<tr>
<td>2.1</td>
<td>Introduction to Sugar Industry.</td>
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<tr>
<td>2.2</td>
<td>Explain manufacturing of Cane Sugar.</td>
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<td>2.3</td>
<td>Describe manufacturing of Beet Sugar.</td>
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<td>2.4</td>
<td>Explain Corn Sweeteners.</td>
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<tr>
<th>3</th>
<th>GLASS INDUSTRY</th>
<th>5 Hours</th>
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<tbody>
<tr>
<td>3.1</td>
<td>Define Glass.</td>
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<td>3.2</td>
<td>Give raw materials used for the manufacturing of Glass.</td>
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<td>3.3</td>
<td>Name types of Furnaces used for the manufacturing of Glass.</td>
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<td>3.4</td>
<td>Explain the manufacturing process of Glass.</td>
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<td>3.5</td>
<td>Describe Shaping of Glass.</td>
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<td>3.6</td>
<td>Describe Annealing of Glass.</td>
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<td>3.7</td>
<td>Explain finishing process.</td>
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<td>3.8</td>
<td>Give types of Glasses.</td>
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<td>3.9</td>
<td>Describe Glass Wool or Fiber Glass.</td>
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<tr>
<th>4</th>
<th>PULP AND PAPER INDUSTRY</th>
<th>7 Hours</th>
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<tr>
<td>4.1</td>
<td>Introduction to Pulp and Paper.</td>
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<tr>
<td>4.2</td>
<td>Describe manufacturing of Pulp.</td>
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<td>4.3</td>
<td>Describe Pulping processes.</td>
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<td>4.4</td>
<td>Describe Pulp preparation for Paper making.</td>
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<tr>
<td>4.5</td>
<td>Describe Paper manufacturing processes.</td>
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<td>4.6</td>
<td>Describe furnishing and converting of Paper.</td>
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<td>4.7</td>
<td>State by products of pulp and paper manufacturing.</td>
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<tr>
<td>4.8</td>
<td>Explain manufacturing of heavy boards and structural boards.</td>
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<tr>
<th>5</th>
<th>WATER AND WATER TREATMENT</th>
<th>10 Hours</th>
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</table>
5.1 Introduction and significance of water.
5.2 State sources of water.
5.3 Describe types of water.
5.4 State types of Impurities in Water.
5.5 Define Hardness of Water and state types of Hardness.
5.6 Describe Boiler Feed Water.
5.7 Describe Softening of Water.
5.8 Describe Potable or Drinking Water.
5.9 Describe treatment of water for Drinking.
5.10 State Desalination of Brackish or Sea Water.
5.11 Describe Waste Water Treatment.
5.12 Describe a Filtration Plant.
5.13 Understand Mineral Water.

**Recommended Textbooks**


**List of Practical:**

92 Hours

1. Relevant Audio-visual programs demonstrating chemical operations, processes, and equipment should be shown to the students.
2. Instructional tours should be arranged to visit various chemical industries where the students can observe various chemical operations, equipment, and safety Precautions. Every student should be advised to prepare in writing a different set of questions (at least there) on various relevant topics to be asked during the tour. The teacher should assist the students in composing and formulating questions.

3. To prepare Models of Different chemical process industries.

4. Determination of percentage loss on ignition of Cement.

5. Determination of percentage of total silica of Cement.


7. Determination of percentage of moisture content of Cement.

8. Determination of percentage of calcium content of Cement.


12. To determine the Total Hardness of Water by EDTA Method.

13. To determine the Permanent Hardness of Water by EDTA Method.

14. To determine the Total Hardness of Water by Clark’s or Soap Titration Method.

15. To determine the Permanent Hardness of Water by EDTA Method.

16. To determine the Alkalinity of Water.

17. To determine the PH Value of Water.

18. To determine the Dissolved Oxygen in Water by Winkler’s Method.

19. To determine the Free Chlorine in Water sample.

20. To determine the Chlorides in Water sample.

21. To determine the Calcium in Water sample.

22. To determine the Magnesium in Water sample.

23. To determine the Nitrates in Water sample.

24. To determine the Free Sulphates in Water sample.

25. To determine the Free Sulphites in Water sample.

26. To determine the Dissolved CO$_2$ in Water sample.

27. To determine the Dissolved H$_2$S in Water sample.
28. To determine the Total Dissolved Solids (TDS) in Water sample.

29. To determine the moisture contents of sugar crystal.

30. To determine the moisture contents of Bagasse.

PCT-352 Instructional Objectives:

1. CEMENT INDUSTRY
   1.1 Introduction to Cement.
      1.1.1 Define Cement.
      1.1.2 Give Classification of Cement.
   1.2 Describe preparation, properties and applications of following types of Cements.
      1.2.1 Natural Cement.
      1.2.2 Puzzolana Cement.
      1.2.3 Slag Cement.
   1.3 Introduction to Portland cement.
   1.4 Explain manufacturing of Portland cement.
      1.4.1 Raw materials of Portland cement.
      1.4.2 Steps involved in processing of Portland cement.
      1.4.3 Crushing
      1.4.4 Mixing
      1.4.5 Burning (Clinker Formation)
      1.4.6 Grinding
   1.5 Compare dry and wet processes of Cement manufacturing.
   1.6 Describe settling and hardening of Cement.
   1.7 Describe physical properties of Portland cement.
   1.8 Explain Decay of Cement, its reasons and prevention.
   1.9 Introduction to Lime.
      1.9.1 Describe types of Lime.
      1.9.2 Describe setting and hardening of Lime.
   1.10 Describe Plaster of Paris.
      1.10.1 Give preparation of Plaster of Paris.
      1.10.2 Describe setting and hardening of Plaster of Paris.
      1.10.3 Describe applications of Plaster of Paris.
   4.11 Enlist important Cement Industries in Pakistan.

2. SUGAR INDUSTRY
   2.1 Introduction to Sugar Industry.
   2.2 Explain manufacturing of Cane Sugar.
2.2.1 Describe production of raw cane sugar.
2.2.2 Explain the cane sugar refining process.
2.2.3 Describe De colorization-Char Filtration process.
2.2.4 Describe Bagasse.
2.2.5 Describe Molasses.
2.3 Describe manufacturing of Beet Sugar.
2.4 Explain Corn Sweeteners.
2.5 Enlist important Sugar and Beverage Industries in Pakistan.

3. GLASS INDUSTRY
3.1 Define Glass.
3.2 Give raw materials used for the manufacturing of Glass.
3.3 Name types of Furnaces used for the manufacturing of Glass.
   3.3.1 Explain construction and working of Pot Furnace.
   3.3.2 Explain construction and working of Tank Furnace.
3.4 Explain the manufacturing process of Glass.
3.5 Describe Shaping of Glass.
   3.5.1 Explain Blowing Method.
   3.5.2 Explain Molding Method.
3.6 Describe Annealing of Glass.
3.7 Explain finishing process.
3.8 Give types of Glasses.
   3.8.1 Soft or Soda Glass.
   3.8.2 Hard or Potash Glass.
   3.8.3 Lead Glass.
   3.8.4 Borosilicate or Pyrex Glass.
   3.8.5 Safety Glass.
   3.8.6 Optical Glass.
3.9 Describe Glass Wool or Fiber Glass.
   3.9.1 Describe properties of Glass Wool.
   3.9.2 Give uses of Glass Wool.
3.10 Enlist important Glass Industries in Pakistan.

4. PULP AND PAPER INDUSTRY
4.1 Introduction to Pulp and Paper.
4.2 Describe manufacturing of Pulp.
   4.2.1 Give the raw materials of Pulp.
   4.2.2 Explain the process of wood preparation.
4.3 Describe Pulping processes.
   4.3.1 Explain Mechanical Pulping.
   4.3.2 Explain Semi chemical Pulping.
   4.3.3 Explain Chemical Pulping.
      i) Describe Kraft Process.
      ii) Describe Sulfite Process.
   4.3.4 Explain Organosolv Pulping.
4.4 Describe Pulp preparation for Paper making.
   4.4.1 Explain screening and cleaning of Pulp.
   4.4.2 Explain bleaching of Pulp.
   4.4.3 Explain recycling and stock preparation.
4.5 Describe Paper manufacturing processes.
   4.5.1 Explain Conical Refiner or Jordan Engine process.
   4.5.2 Explain Fourdrinier Machine process.
4.6 Describe furnishing and converting of Paper.
4.7 State by products of pulp and paper manufacturing.
4.8 Explain manufacturing of heavy boards and structural boards.
4.9 Enlist important Paper Industries in Pakistan.

5. WATER AND WATER TREATMENT
   5.1 Introduction and significance of water.
   5.2 State sources of water.
   5.3 Describe types of water.
      5.3.1 Define River Water.
      5.3.2 Define Lake Water.
      5.3.3 Define Rain Water.
      5.3.4 Define Underground Water.
      5.3.5 Define Sea Water.
   5.4 State types of Impurities in Water.
      5.4.1 Describe Suspended Impurities.
      5.4.2 Describe Colloidal Impurities.
      5.4.3 Describe Dissolved Impurities.
      5.4.4 Describe Micro-organisms Impurities.
   5.5 Define Hardness of Water and state types of Hardness.
      5.5.1 Explain Temporary Hardness.
      5.5.2 Explain Permanent Hardness.
      5.5.3 Define Degree of Hardness.
      5.5.4 Differentiate between Hard and Soft Water.
      5.5.5 Give advantages and disadvantages of Hard Water.
   5.6 Describe Boiler Feed Water.
      5.6.1 Give characteristics of Boiler Feed Water.
      5.6.2 State Boiler Problems.
      5.6.3 Explain Sludge and Scale formation, their causes and prevention.
      5.6.4 Differentiate between scale and sludge.
      5.6.5 Explain Priming and Foaming, their causes and remedy.
      5.6.6 Explain Boiler Corrosion, its causes and prevention.
      5.6.7 Explain Caustic Embrittlement, its causes and prevention.
   5.7 Describe Softening of Water.
      5.7.1 Define Softening and state treatment methods.
      5.7.2 Differentiate between External and Internal Treatment.
      5.7.3 State External Treatment Processes.
         i) Explain Cold and Hot Lime Soda Processes. Also give their differences.
         ii) Explain Zeolite or Permutit Process. Also give its limitations.
         iii) Explain Ion Exchange Process for Demineralization.
      5.7.4 State Internal Treatment Processes.
         i) Explain Colloidal Conditioning.
         ii) Explain Carbonate Conditioning.
         iii) Explain Colgon Conditioning.
         iv) Explain Phosphate Conditioning.
   5.8 Describe Potable or Drinking Water.
      5.8.1 Give characteristics of Potable Water.
      5.8.2 State quality standards (ISI and WHO) for Potable Water.
5.9 Describe treatment of water for Drinking.

5.9.1 State treatment methods for Potable Water.

5.9.2 Explain Screening.

5.9.3 Explain Sedimentation.

5.9.4 Explain Sedimentation with Coagulation.

5.9.5 Explain Filtration.

5.9.6 Explain methods for Removal of Micro-organisms.
   i) By adding Bleaching Powder.
   ii) By Chlorination.
   iii) By Ozone.

5.10 State Desalination of Brackish Water.

5.10.1 State different methods of Desalination of Brackish Water.

5.10.2 Explain Distillation.

5.10.3 Explain Freezing.

5.10.4 Explain Electro dialysis.

5.10.5 Explain Reverse Osmosis. Also give its advantages.

5.11 Describe Waste Water Treatment.

5.11.1 State Objectives of Waste Water Treatment.

5.11.2 Describe different methods for Waste Water Treatment.

5.11.3 Explain Preliminary Process.

5.11.4 Explain Settling Process.

5.11.5 Describe Biological Treatment Processes.
   i) Explain Trickling Filter Process.
   ii) Explain Activated Sludge Process.

5.12 Describe a Filtration Plant.

5.13 Explain Mineral Water.
PCT-364 Petrochemical Industries-2

Total Contact Hours

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<tr>
<td>Theory:</td>
<td>64Hrs</td>
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<td>6</td>
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<tr>
<td>Practical:</td>
<td>192Hrs</td>
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Pre-requisites: Petrochemical Industries-1

Course Objectives:

1. To assist the student in understanding fundamental Principles of petrochemicals.
2. Understand important manufacturing procedure employed by modern petrochemical industries.
3. Understand different chemical processes commonly employed in petrochemical industries.
4. Chemical production equipment related to these processes.
5. Enable the student to draw flow sheet diagram.

Detail Course Contents:

1 FERTILIZERS 10 Hours

1.1 Define a Fertilizer.
   1.1.1 Use of Fertilizers.
   1.1.2 Give classification of Fertilizers.
1.2 Describe Nitrogenous Fertilizers.
1.3 Describe Phosphorous Fertilizers.
1.4 Describe Potassium Fertilizers.
1.5 Describe Mixed Fertilizers.

2 OIL, FATS, SOAPS AND DETERGENTS 8 Hours

2.1 Understand Oils and Fats. Give their properties.
   2.1.1 How Oils and Fats are analyzed.
   2.1.2 Describe Hydrogenation of Oils and Fats.
2.2 Understand Vegetable Ghee. Explain it preparation.
2.3 Understand Soap. Explain it preparation.
   2.2.1 Give the classification of Soaps.
2.4 Understand detergents and Surfactants. Explain their preparation.

3 PAINTS, VARNISHES AND LACQUOERS 10 Hours

3.1 Understand Paint. Give their required properties.
   3.1.1 Describe manufacturing of Paints.
3.2 Explain Pigments.
3.3 Understand Enamels.
3.4 Describe Lacquers.
3.5 Explain Varnishes.
4 EXPLOSIVES AND PROPELLANTS  5 Hours
4.1 Define an Explosive.
   4.1.1 Give characteristics of Explosives.
   4.1.2 Give Classification of Explosives.
   4.1.3 Describe methods of preparation of some Explosives.
4.2 Understand Blasting Fuses.
4.3 Define Propellant.
   4.3.1 Describe characteristics and Classification of Propellants.

5 INSECTICIDES AND PESTICIDES  5 Hours
5.1 Define Insecticides. Also give its types.
5.2 Define Pesticides.
5.3 Understand Fumigants.
5.4 Describe Fungicides.

6 ADHESIVES  5 Hours
6.1 Define an Adhesive.
6.2 Describe Advantages and Limitations of Adhesive Bonding.
6.3 Explain Bonding Process.
6.4 Give classification of Adhesives.

7 DYES, DYE INTERMEDIATES AND DYEING  9 Hours
7.1 Define Dyes.
7.2 Describe manufacturing methods for Dye Intermediates.
7.3 Give Classification of Dyes.
7.4 Explain process of dyeing some products.

8 BIOTECHNOLOGY  12 Hours
8.1 Introduction to Biotechnology.
8.2 Industrial applications of Biotechnology.
8.3 Fermentation and its uses.
8.4 Preparation of Industrial Alcohol.
8.5 Absolute Alcohol.
8.6 Production of Acetone.
8.7 Production of Acetic Acid.
8.8 Production of Vitamins.
8.9 Production of Beers.
8.10 Production of Vines.
8.11 Production of Vinegar.
8.12 Production of Biofuels.
8.13 Production of Biofertilizers.
8.14 Biopolymers.
List of Practical: 192 Hours

1. Understand Safety in laboratory.

2. Relevant Audio-visual programs demonstrating chemical operations, processes, and equipments should be shown to the students.

3. Instructional tours should be arranged to visit various petrochemical industries where the students can observe various petrochemical operations, equipments, and safety Precautions. Every student should be advised to prepare in writing a different set of questions (at least there) on various relevant topics to be asked during the tour. The teacher should assist the students in composing and formulating questions.

4. To study and make Models of Different Processes and Industries.

5. To visit the different Industries and submit reports.

6. To understand different Processes with the help of Videos.

7. Preparation of benzene sulfonic Acid.

8. Preparation of Aniline black dye.


11. Preparation of Methyl Orange

12. Preparation of Purple Blue Dye.


14. Practice Coloring of cotton cloth with different dies.

15. To determine Melting point of Fats.

16. To determine Saponification Number of Oils and Fats.

17. To determine Iodine Number of Oils and Fats.

18. To determine Acid Number of Oils and Fats.

19. To prepare moisturizing Lotion and Vaseline.

20. To distinguish Drying and Non-drying oil by Elaiden Test.
21. To determine Free Fatty Acids (FFA) of Oils and Fats.

22. To Prepare Soap.

23. To prepare shampoo.


25. Preparation of Baked Bread.

26. To test Glucose and Fructose.

27. To test Sucrose and Maltose.

28. To test sugar level in the blood with Glucometer.

29. Estimation of Urea by Hypobromite Method.

30. Estimation of Urea by Urease Method.


32. Preparation of Ammonium Sulphate.

33. To study the Fireworks.

34. To study and apply the Alphi and Adhesive Bond.

35. To study and apply the Magic Bond and Glue.

36. To study and apply Nail Polish.

37. To study and apply Mosquito repellant Coils.

38. To study the action of Dettol Lotion and Soap.

39. To study and apply Mosquito repellant Lotions.

40. To prepare special color by mixing different colored paint.

41. To practice applying of different paints and enamels.

42. To add some preservative in a juice for maintaining its quality.

**Recommended Textbooks:**

PCT-364 Instructional Objectives:

1. FERTILIZERS INDUSTRY
   1.1 Introduction to Fertilizers.
      1.1.1 Describe the benefits of using Fertilizers.
      1.1.2 Give the classification of Fertilizers.
      1.1.3 Describe some Organic (Natural) Fertilizers.
1.1.4 What are two types of Mineral (Artificial) Fertilizers?
1.1.5 Enlist most important Mineral Fertilizers.
1.2 Describe Nitrogenous Fertilizers.
1.2.1 Name important Nitrogenous Fertilizers.
1.2.2 Explain manufacturing and uses of Ammonium Nitrate.
1.2.3 Explain manufacturing and uses of Urea.
1.2.4 Explain manufacturing and uses of Ammonium Sulphate.
1.3 Describe Phosphorous Fertilizers.
1.3.1 Name important Phosphorous Fertilizers.
1.3.2 Explain manufacturing and uses of Superphosphate.
1.3.3 Explain manufacturing and uses of Triple superphosphate.
1.4 Describe Potassium Fertilizers.
1.4.1 Name important Potassium Fertilizers.
1.4.2 Explain manufacturing and uses of Potassium Sulphate.
1.4.3 Explain manufacturing and uses of Potassium Nitrate.
1.5 Describe Mixed Fertilizers.
1.5.1 Name important Mixed Fertilizers.
1.5.2 Explain manufacturing and uses of Ammonium Phosphate.
1.5.3 Explain manufacturing and uses of Di-Ammonium Phosphate.
1.6 Describe the working of Prilling Tower.
1.7 Enlist important Fertilizer Industries in Pakistan.

2. OILS, FATS, SOAPS AND DETERGENTS
2.1 Introduction to Oils and Fats.
2.1.1 Give sources of Oils and Fats.
2.1.2 Differentiate between Oils and Fats.
2.1.3 Describe origin of Vegetable Oils.
2.1.4 Describe extraction of Vegetable Oils.
2.1.5 Give Chemical Properties of Oils and Fats.
2.1.6 Describe the Analysis of Oils and Fats.
2.2 Describe the manufacturing of Vegetable Ghee.
2.2.1 Give the raw materials of Vegetable Ghee.
2.2.2 Explain the manufacturing process of Vegetable Ghee.
2.3 Introduction to Soaps.
2.3.1 Give the raw materials of Soaps.
2.3.2 Give types of Soaps.
2.3.3 Give the uses of Soaps.
2.3.4 Explain the manufacturing process of Soap.
   i) Describe Kettle Process.
   ii) Describe Hydrolyser Process.
2.3.5 Describe some typical Soaps e.g. Toilet Soap, Transparent Soap, etc.
2.3.6 Explain the cleansing action of Soap.
2.4 Explain recovery of Glycerine from Spent Lye of Soap manufacturing process.
2.5 Introduction to Synthetic Detergents.
2.5.1 Give classification of Detergent.
2.5.2 Describe manufacturing of Non-Ionic Detergents.
2.5.3 Give introduction and classification of Surfactants.
2.5.4 Explain production of Alkyl Benzene Sulphonate.
2.11 Enlist important Soap, Cooking Oil and Ghee Industries in Pakistan.
3. PAINTS, VARNISHES AND LACQUOERS
  3.1 Introduction to Paints.
    3.1.1 Define Paint.
    3.1.2 Describe required properties of Paint.
    3.1.3 Describe constituents of Paints and their functions.
    3.1.4 Explain the manufacturing process of Paints.
  3.2 Introduction to Pigments.
    3.2.1 Describe required properties of Pigments.
    3.2.2 Name different types of Pigments.
    3.2.3 Explain manufacturing of White Lead Pigment.
    3.2.4 Explain manufacturing of Zinc Oxide Pigment.
  3.3 Define Varnish.
    3.3.1 Describe differences of Varnishes and Paints.
    3.3.2 Give raw materials of Varnishes.
    3.3.3 Give additives for Varnishes and their function.
    3.3.4 Describe types of Varnishes.
  3.4 Define Enamel.
    3.4.1 Describe raw materials for Enamels.
    3.4.2 Give raw materials for Varnishes and their function.
  3.5 Introduction to Emulsions.
    3.5.1 Define Emulsions.
    3.5.2 Give advantages and properties of Emulsions.
    3.5.3 Describe constituents of Emulsions and their functions.
    3.5.4 Explain application process of Emulsions.
  3.6 Understand Paint Remover.
    3.6.1 Describe required properties of Paint Removers.
    3.6.2 Describe types and composition of Paint Removers.
    3.6.3 Explain application process of Paint Removers.
  3.7 Enlist important Paint Industries in Pakistan.

4. EXPLOSIVES AND PROPELLANTS
  4.1 Introduction to Explosives.
    4.1.1 Define Explosives.
    4.1.2 Describe requisites of Explosives.
    4.1.3 Define oxygen balance.
    4.1.4 Give classification of Explosives.
    4.1.5 Describe Primary Explosives or Detonators.
    4.1.6 Describe Low Explosives and their types.
    4.1.7 Describe High Explosives and their types.
  4.2 Explain preparation methods for some Explosives.
  4.3 Define Blasting Fuses and their types.
  4.4 Describe applications of Explosives.
  4.5 Define Rocket Propellants.
    4.5.1 Define Specific Thrust.
    4.5.2 Give characteristics of a good Propellant.
    4.5.3 Give classification of Propellants.
    4.5.4 Describe Solid Propellants.
    4.5.5 Describe Liquid Propellants.
5. INSECTICIDES AND PESTICIDES

5.1 Introduction to Insecticides and Pesticides.
   5.1.1 Define Insecticides.
   5.1.2 Define Pesticides.
   5.1.3 Give classification of Insecticides.

5.2 Describe preparation, properties and uses of following types of Organic Insecticides.
   5.2.1 Dinitrophenol.
   5.2.2 Dicophane.
   5.2.3 B.H.C or Benzene Hexachloride.
   5.2.4 Chlordane.
   5.2.5 Aldrin.
   5.2.6 Malathion.
   5.2.7 Parathion.

5.3 Understand Fumigants.

5.4 Describe preparation, properties and uses of following types of Fumigants.
   5.4.1 Ethylene Dibromide.
   5.4.2 Ethylene Dichloride.
   5.4.3 Para-Dichlorobenzene.

5.5 Understand Fungicides.

5.6 Describe preparation, properties and uses of following types of Fungicides.
   5.6.1 Mercuric Chloride.
   5.6.2 Mercurous Chloride.
   5.6.3 Pentachlorophenol.

6. ADHESIVES

6.1 Introduction to Adhesives.
   6.1.1 Define an Adhesive.
   6.1.2 Enlist the factors affecting the quality of An Adhesive.
   6.1.3 Describe the adhesive action of an Adhesive.
   6.1.4 Explain the development of adhesive strength of an Adhesive.

6.2 Describe the Advantages and Limitations of Adhesive Bonding.

6.3 Describe the factors affecting the adhesive action of an Adhesive.

6.4 Explain the following steps for the process of bonding.
   6.4.1 Preparation of Adherends.
   6.4.2 Preparation of Adhesive.
   6.4.3 Application of Adhesive.
   6.4.4 Joining the adhesive coated Adherends.
   6.4.5 Application of Pressure and Temperature.
   6.4.6 Conditioning after bonding.

6.5 Classify Adhesives.
   6.5.1 Classification on the basis of occurrence.
   6.5.2 Classification on the basis of Mechanism of Adhesion.

6.6 Define with examples and give uses of following types of Adhesives.
   6.6.1 Solvent Responsive Adhesives.
   6.6.2 Heat Sealing Adhesives.
   6.6.3 Pressure Sensitive Adhesives.
   6.6.4 Chemically Reactive Adhesives.
7. **DYES, DYE INTERMEDIATES AND DYEING**
   a. Introduction to Dyes and Dyeing.
      i. Define Dyes.
      ii. How Dyes are classified.
      iii. Describe each type of Dye with examples.
   b. Explain different Dye Intermediates petrochemicals.
   c. Explain the process of Dyeing.
      i. Describe theories of Dyeing.
      ii. Describe Dyeing Machinery.
      iii. Describe Dyeing process of Wool with Acid Dye.
      iv. Describe Dyeing process of Acrylic Fiber with Basic Dye.
      v. Explain the process of Textile Printing.
      vi. Explain the process of Paper coloring.
      vii. Describe the process of Leather Dyeing.
   d. Describe Non-textile use of Dyes.
      i. Liquid Crystal Dyes.
      ii. Ink-Jet Dyes.
      iii. Organic Photoconductors and Toners.
      iv. Laser Dyes.
      v. Biomedical Dyes.
      vi. Hair Dyes.
      vii. Photographic Dyes.

8. **BIOTECHNOLOGY**
   a. Understand Biotechnology.
      i. Define Biotechnology.
      ii. Describe development of Biotechnology.
         8.1.3 Give applications of Biotechnology in different fields.
   b. Describe Biotechnological Processes.
   c. Introduction to Fermentation.
      8.3.1 Give requisite of good Fermentation process.
      8.3.2 Use of Fermentation in different industries.
   d. Understand Industrial Alcohol.
      i. Give the raw materials of Industrial Alcohol.
      ii. Describe the manufacturing of Industrial Alcohol.
      iii. Give uses of Industrial Alcohol.
   e. Describe the production of Absolute Alcohol.
   f. Explain the production of Acetone.
   g. Explain the production of Acetic Acid.
      i. Describe the production of Acetic Acid by Surface process.
      ii. Describe the production of Acetic Acid by Submerged process.
   h. Explain production of Vitamins.
      i. Describe raw materials and preparation of Beers.
      j. Describe raw materials and preparation of Vines.
      k. Describe raw materials and preparation of Vinegar.
   l. Introduction to Biofuels.
      i. Give advantages and disadvantages of Biofuels.
      ii. Give types and preparation of Biofuels.
   m. Introduction to Biofertilizers.
      i. Give benefits and limitations of Biofertilizers.
ii. Describe some important Biofertilizers.

8.14 State Biopolymers.

8.15 Describe following types of Biopolymers.
   8.15.1 Carbohydrates.
   8.15.2 Proteins.
   8.15.3 Nucleic Acids.
Total Contact Hours

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Pre-requisites: None

Course Objectives: After completing this course, the students will be able to;
1. Understand different polymers and polymerizations.
2. Differentiate between different types of Plastics and Rubbers.
3. Understand different Plastic and rubber processing methods like extrusion, Injection molding, blow molding, thermoforming, Foaming, Compression molding and Casting.

Detail Course Contents:

Part-1: Polymers and Plastics

1. POLYMERS AND POLYMERIZATION 6 Hours
   1.1 Introduction to Polymers and Polymerization
   1.2 State Advantages and drawbacks of using Polymers.
   1.3 Give applications of Plastics in different fields of life.
   1.4 Define Polymerization and state its types.
   1.5 Explain Step and Chain Growth Polymerization.
   1.6 Describe Copolymerization with examples.
   1.7 Explain Polymerization Techniques.
   1.8 Understand the reactors used for Polymerization.
   1.9 Describe different types of catalyst used in Polymerization.
   1.10 Describe main types of Resins, their properties and Applications.

2. THERMOPLASTICS 6 Hours
   2.1 Give introduction to Thermoplastics.
   2.2 Describe properties of Thermoplastics.
   2.3 Explain manufacturing methods of some Commodity Thermoplastics.
   2.4 Explain manufacturing methods of some Commodity Thermoplastics.

3. THERMOSETTING PLASTICS 6 Hours
   3.1 Give introduction to Thermosetting Plastics.
   3.2 Describe properties of Thermosetting Plastics.
   3.3 Explain manufacturing methods of some Thermosetting Plastics.
   3.5 Describe preparation and uses of Epoxy Resins.
   3.6 Describe preparation and uses of Polyurethanes.
   3.7 Differentiate between Thermoplastics and Thermosetting Plastics.

4. RUBBERS 6 Hours
   4.1 Give introduction to Rubber.
   4.2 State types of Rubbers.
4.3 Describe Natural Rubber.
4.4 Describe Synthetic Rubber.
4.5 Describe preparation, properties and uses of Synthetic Rubbers.
   4.5.1 Describe preparation of Polybutadiene.
   4.5.2 Describe preparation of Polyisoprene.
   4.5.3 Describe preparation of Ethylene Propylene Rubber (EPR).
   4.5.4 Describe preparation of Styrene Butadiene Rubber (SBR).
   4.5.5 Describe preparation of Acrylonitrile Butadiene Rubber (ABR).
4.6 Describe Processing of Rubbers.

5. ADDITIVES FOR PLASTICS  4 Hours
5.1 Give introduction to the Additives used for Plastics.
5.2 State different types of Additives.
5.3 Describe different types of Additives and their purpose.
   5.3.1 Fillers  5.3.2 Plasticizers and Softeners
   5.3.3 Lubricators and Promoters  5.3.4 Anti-aging Additives
   5.3.5 Flame Retarders  5.3.6 Colorants
   5.3.7 Blowing Agents   5.3.8 Cross Linking Agents
   5.3.9 Photodegradants  5.3.10 2-Oxazolines

Part-2: Plastics Processing

6. EXTRUSION  4 Hours
6.1 Define Extrusion.
6.2 Describe Extrusion Equipment.
6.3 Explain the construction of Extruder.
6.4 Describe Single Screw and Multiple Screw Extruders.
6.5 State the zones of Single Screw Extruder.
6.6 Explain the process of Extrusion.
6.7 Describe Profile Extrusion and Co-Extrusion.

7. INJECTION MOULDING  4 Hours
7.1 Define Injection Moulding.
7.2 Describe the main units of Injection Moulding Machine.
7.3 Explain the process of Injection Moulding.
7.4 Describe Co-Injection and Injection Compression Moulding.

8. BLOW MOULDING  4 Hours
8.1 Define Blow Moulding.
8.2 Describe process steps involved in Blow Moulding.
8.3 State types of Blow Moulding.
8.4 Give comparison between Extrusion and Injection Blow Moulding.

9. THERMOFORMING  4 Hours
9.1 Define Thermoforming.
9.2 Give differences and advantages of Thermoforming.
9.3 State different Thermoforming processes.
9.4 Describe Thermoforming processes.

10. FOAMING  4 Hours
10.1 Define Foaming.
10.2 Give types and properties of Foams.
10.3 Describe different processes to create Foam in Resins.
10.4 State processes to shape and solidify Foams.
10.5 Describe processes to shape and solidify Foams.

11. COMPRESSION MOULDING  4 Hours
11.1 Define Compression Moulding.
11.2 Describe Compression Moulding Machines.
11.3 Describe Mould and Mould Closure Types.
11.4 Explain the process of Compression Moulding.

12. TRANSFER MOULDING 4 Hours
12.1 Define Transfer Moulding.
12.2 Describe Moulds for Transfer Moulding.
12.3 Describe process of Transfer Moulding.
12.4 Give comparison between Compression and Transfer Moulding.

13. CASTING 4 Hours
13.1 Define Casting.
13.2 State different Casting processes.
13.3 Explain different Casting processes.

14. RECYCLING OF POLYMERS 4 Hours
14.1 Describe Recycling of Polymers.
14.2 Describe Outline of Recycling Methods.
14.3 Explain direct reuse of Polymers.
14.4 Describe Reuse after Modifications.
14.5 Describe Recycling of PVC.
14.6 Describe Recycling of cured Epoxies.
14.8 Describe Recycling of Rubber Tires.
List of Practical:  

1. Relevant Audio-visual programs demonstrating Polymer and Plastic Processing operations, and equipments should be shown to the students.
2. Instructional tours should be arranged to visit various Plastic Processing Industries where the students can observe various operations, equipments, and safety Precautions. Every student should be advised to prepare in writing a different set of questions (at least there) on various relevant topics to be asked during the tour. The teacher should assist the students in composing and formulating questions.
3. To study the Glass Transition Temperature, Crystallization and Melting Behavior of Plastics.
4. To study the Mechanical Properties of Plastics.
5. To study the Rheological classifications of Plastics.
6. To draw a table and understand Classes of polymers, their characteristics and Applications.
7. To make Models of different Moulding and Forming Machines.
8. To draw sketch and study the working of single screw Extruder.
9. To draw sketch and study the working of Injection Moulding Machine.
10. To draw sketch and study the working of Extrusion Blow Moulding Process.
11. To draw sketch and study the working of Injection Blow Moulding Process.
12. To draw sketch and study the working of Compression Moulding Machine.
13. To draw sketch and study the working of Snap Back Forming Process.
14. To draw sketch and study the working of Matched Die Forming Process.
15. To draw sketch and study the working of Single Station Thermoforming Machine.
16. To draw sketch and study the working of Mould Casting Process.
17. To draw sketch and study the working of Continuous and Film Casting Process.
18. To draw sketch and study the working of Low and High Pressure Foam Moulding Process.
19. To draw sketch and study the working of Transfer Moulding Process.
20. To draw sketch and study the working of Sheet Moulding Compound (SMC) Process.
21. To draw sketch and study different types of Dies.
22. To study different types of Additive for Plastics and their purposes.
23. To determine the Melting Point of different Plastic resins.
25. To practice of forming different articles on Blow Moulding Machine.
27. To practice forming of Pipe and Rod on Single Screw Extruder.
28. To understand Recycling Techniques for Plastic waste.
PCT-373 Instructional Objectives:

Part-1: Polymers and Plastics

1. POLYMERS AND POLYMERIZATION
   1.1 Introduction to Polymers and Polymerization.
      1.1.1 Enlist examples of polymers from daily life.
      1.1.2 Define a polymer.
      1.1.3 Give classification of Polymers.
      1.1.4 What is Functionality of Polymers?
   1.2 State Advantages and drawbacks of using Polymers.
   1.3 Give applications of Plastics in different fields of life.
   1.4 Define Polymerization, give its Mechanism and state its types.
      1.4.1 Describe Addition Polymerization with examples.
      1.4.2 Describe Condensation Polymerization with examples.
      1.4.3 Differentiate between Addition and Condensation Polymerization.
   1.5 Explain Step and Chain Growth Polymerization.
   1.6 Describe Copolymerization with examples.
      1.6.1 State types of Copolymers.
      1.6.2 State advantages of Copolymerization.
   1.7 Explain Polymerization Techniques.
      1.7.1 Describe Bulk Polymerization.
      1.7.2 Describe Solution Polymerization.
      1.7.3 Describe Suspension Polymerization.
      1.7.4 Describe Emulsion Polymerization.
   1.8 Understand the reactors used for Polymerization.
   1.9 Describe different types of catalyst used in Polymerization.
   1.10 Describe main types of Resins, their properties and Applications.
   1.11 Enlist important Plastic and Rubber Industries in Pakistan.

2. THERMOPLASTICS
   2.1 Give introduction to Thermoplastics.
   2.2 Describe properties of Thermoplastics.
   2.3 Explain manufacturing methods of some Commodity Thermoplastics.
      2.3.1 Describe preparation and uses of Low and High Density Polyethylene.
      2.3.2 Differentiate Low and High Density Polyethylene.
      2.3.3 Describe preparation and uses of Polypropylene.
      2.3.4 Describe preparation and uses of Poly Vinyl Chloride.
      2.3.5 Differentiate between Rigid and Plasticized Poly Vinyl Chloride.
   2.4 Explain manufacturing methods of some Commodity Thermoplastics.
      2.4.1 Describe preparation and uses of Polyamides or Nylons.
      2.4.2 Describe preparation and uses of Polycarbonates.
3. THERMOSETTING PLASTICS.
   3.1 Give introduction to Thermosetting Plastics.
   3.2 Describe properties of Thermosetting Plastics.
   3.3 Explain manufacturing methods of some Thermosetting Plastics.
      3.3.1 Describe preparation and uses of Phenol Formaldehyde (Phenolic Resin).
      3.3.2 Describe preparation and uses of Urea Formaldehyde.
      3.3.3 Describe preparation and uses of Melamine Formaldehyde.
   3.4 Describe preparation and uses of Polyesters.
      3.4.1 State additives for Polyester.
      3.4.2 Describe Laminating Resins.
      3.4.3 Describe Moulding Compounds.
   3.5 Describe preparation and uses of Epoxy Resins.
   3.6 Describe preparation and uses of Polyurethanes.
   3.7 Differentiate between Thermoplastics and Thermosetting Plastics.

4. RUBBERS
   4.1 Give introduction to Rubber.
   4.2 State types of Rubbers.
   4.3 Describe Natural Rubber.
      4.3.1 State source of Natural Rubber.
      4.3.2 Describe processing of Natural Rubber.
      4.3.3 Describe Creep and Smoked Rubber.
      4.3.4 Explain Vulcanization of Natural Rubber.
      4.3.5 State Advantages of Vulcanized Rubber.
   4.4 Describe Synthetic Rubber.
   4.5 Describe preparation, properties and uses of Synthetic Rubbers.
      4.5.1 Describe preparation of Polybutadiene.
      4.5.2 Describe preparation of Polyisoprene.
      4.5.3 Describe preparation of Ethylene Propylene Rubber (EPR).
      4.5.4 Describe preparation of Styrene Butadiene Rubber (SBR).
      4.5.5 Describe preparation of Acrylonitrile Butadiene Rubber (ABR).
   4.6 Describe Processing of Rubbers.
      4.6.1 Explain Compounding.
      4.6.2 Explain Performing.
      4.6.3 Explain Moulding.
      4.6.4 Explain Dipping.

5. ADDITIVES FOR PLASTICS
   5.1 Give introduction to the Additives used for Plastics.
   5.2 State different types of Additives.
   5.3 Describe different types of Additives and their purpose.
      5.3.1 Fillers  5.3.2 Plasticizers and Softeners
      5.3.3 Lubricators and Promoters  5.3.4 Anti-aging Additives
      5.3.5 Flame Retarders  5.3.6 Colorants
      5.3.7 Blowing Agents  5.3.8 Cross Linking Agents
      5.3.9 Photodegradants  5.3.10 2-Oxazolines

Part-2: Plastics Processing

6. EXTRUSION
   6.1 Define Extrusion.
   6.2 Describe Extrusion Equipment.
6.3 Explain the construction of Extruder.
6.4 Describe Single Screw and Multiple Screw Extruders.
6.5 State the zones of Single Screw Extruder.
   6.5.1 Describe Feed Zone.
   6.5.2 Explain Compression Zone.
   6.5.3 Describe Metering Zone.
   6.5.4 Describe Die Zone and Die.
6.6 Explain the process of Extrusion.
6.7 Describe Profile Extrusion and Co-Extrusion.

7. INJECTION MOULDING
7.1 Define Injection Moulding.
7.2 Describe the main units of Injection Moulding Machine.
   7.2.1 Explain Injection Unit.
   7.2.2 Explain Drive System.
   7.2.3 Explain the Clamping Unit.
   7.2.4 Explain the Die and its cooling.
7.3 Explain the process of Injection Moulding.
7.4 Describe Co-Injection and Injection Compression Moulding.

8. BLOW MOULDING
8.1 Define Blow Moulding.
8.2 Describe process steps involved in Blow Moulding.
8.3 State types of Blow Moulding.
   8.3.1 Explain Extrusion Blow Moulding.
   8.3.2 Explain Injection Blow Moulding.
8.4 Give comparison between Extrusion and Injection Blow Moulding.

9. THERMOFORMING
9.1 Define Thermoforming.
9.2 Give differences and advantages of Thermoforming.
9.3 State different Thermoforming processes.
9.4 Describe Thermoforming processes.
   9.4.1 Explain Straight Vacuum Forming.
   9.4.2 Explain Pressure Forming.
   9.4.3 Explain Plug Assisted Forming.
   9.4.4 Explain Drape Forming.
   9.4.5 Explain Matched Die Forming.

10. FOAMING
10.1 Define Foaming.
10.2 Give types and properties of Foams.
10.3 Describe different processes to create Foam in Resins.
   10.3.1 Explain Mechanical Foaming.
   10.3.2 Explain Chemical Foaming.
   10.3.3 Explain Physical Foaming.
   10.3.4 Explain Hollow Glass Foaming.
10.4 State processes to shape and solidify Foams.
10.5 Describe processes to shape and solidify Foams.
   10.5.1 Explain Foam Moulding.
   10.5.2 Explain Extrusion Foaming.
   10.5.3 Explain Casting Foams.
   10.5.4 Explain Expanded Foam Moulding.

11. COMPRESSION MOULDING
11.1 Define Compression Moulding.
11.2 Describe Compression Moulding Machines.
11.3 Describe Mould and Mould Closure Types.
11.4 Explain the process of Compression Moulding.

12. TRANSFER MOULDING
12.1 Define Transfer Moulding.
12.2 Describe Moulds for Transfer Moulding.
12.3 Describe process of Transfer Moulding.
12.4 Give comparison between Compression and Transfer Moulding.

13. CASTING
13.1 Define Casting.
13.2 State different Casting processes.
13.3 Explain different Casting processes.
   13.3.1 Describe Mould Casting.
   13.3.2 Describe Slush Casting.
   13.3.3 Describe Continuous Casting.
   13.3.4 Describe Film or Solvent Casting.

14. RECYCLING OF POLYMERS
14.1 Describe Recycling of Polymers.
14.2 Describe Outline of Recycling Methods.
14.3 Explain direct reuse of Polymers.
14.4 Describe Reuse after Modifications.
14.5 Describe Recycling of PVC.
14.6 Describe Recycling of cured Epoxies.
14.8 Describe Recycling of Rubber Tires.
Minimum Qualification of Teacher/ Instructor

- M.Sc. in Chemical/ PetroleumEngg.

- B.Sc. in with Chemical / PetroleumEngg. with 2-Years’ relevant experience in teaching/ industry

- B-Tech. / B.Sc. Tech. in Chemical Technology with 4-Years’ relevant experience in teaching/ industry

- DAE in Chemical / PetroleumTechnology, with 6-Years’ relevant experience in teaching/ industry
## Curriculum Revision Committee

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<thead>
<tr>
<th>Sr. No</th>
<th>Name &amp; Designation</th>
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<tbody>
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