CURRICULUM FOR
DIPLOMA OF ASSOCIATE
ENGINEER
IN
GLASS, CERAMICS & POTTERY
TECHNOLOGY
(3 - Years Course)
INTRODUCTION

The important characteristics of the ceramics industry are that it is the basic of the successful operation of many other industries. Refractories are the basic components of the metallurgical industry. Abrasives are essential to the Machine tool and automobiles Industry. Glass products are also essential to the automobiles Industry as well as architectural, electronic and electrical industries. For various special electrical, magnetic instrument are made of glass & ceramics is essential for the development of electronic control devices computers etc. Modern ceramics play a very important role in Rocketry, Missile and in Satellites. Reactors are absolutely dependant on modern ceramics materials as a matter of fact almost in every industrial production line, Offices and Homes are dependent on ceramics Materials. Newly developed devices are being incorporated with ceramics materials because of their useful chemical, electrical mechanical thermal and structural properties. Thus ceramics are important because this is the need of a large and basic Industry and also their properties are critical for many applications.
**OBJECTIVES**

1) To train the students in various production techniques
2) Students are trained to be capable to identify, and analyze the ceramics materials and also to produce ceramics ware like insulators, Table wares, Tiles, Sanitary wares etc. from the local raw materials.
3) To familiarize the students with the machinery and equipments their installation and operations used in the glass industry.
4) To train the students in the design of various types of furnaces Kilns used in Glass and Ceramics Industry.
5) To familiarize the students with the formations of body and glazes.
6) To train the students for the eliminations of defects which come across in the running Industries.

**Curriculum Salients:**

- **Entry Level**
  - Matric (Science)

- **Duration of Course**
  - 3-Year

- **Training Methodology**
  - Practical (46%)
  - Theory (54%)
  
  1. **1st Year**
     - Practical (40%)
     - Theory (60%)

  2. **2nd Year**
     - Practical (37%)
     - Theory (63%)

- **Instructional Media**
  - Urdu
  - English
## Scheme Of Studies

### Glass, Ceramics & Pottery Development (3-Year Course)

<table>
<thead>
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<td>Basic Chemical Engineering</td>
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<td>Particle size reduction and glazes</td>
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FIRST YEAR
 nº 3

الإسلاميات/المطالعه باكستان

حصص الإعداد الأول

101

4

كتاب وسنن

قرآن مجيد

1. تأريخ القرآن

- 1. ننالوا لن تفقوا مما نحبون

- 2. واعتصموا بخالد الله جمعا ولا تفرقوا

- 3. ولا يجرمنكم شتان قوم على إن لا تعدلوا

- 4. إن الله يأمركم أن تدوا الأمانات التي أهليها

- 5. إن الله يأمر بالعدل والاحسان

- 6. إن الصلاة تنهى عن الفحشاء والمنكر

- 7. لقد كان لكم في رسول الله حسنة

- 8. إن أكركم عند الله انقاكم

- 9. وما أنا لكم الرسول فخذوه ومانهاكم عنه فانهور

- 10. واعشاون بالمعروف

- 11. يمحق الله الريز ويرمي الصدقات

- 12. واصبر على ما أصابك

- 13. وقولوا فلا سدينا

- 14. إن الدين عند الله الإسلام

- 15.
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| عیب اسلام | | عدد | 2 |
| ---------- | | 2.1 | 1 |
|            | | 2.2 | 5 |

| عیب | | عدد | 2 |
|-----| | 2.2 | 5 |
| 1   | نوزَر  | 2 |
| 2   | نوزَر  | 3 |
| 3   | جُنت  | 4 |
| 4   | زِکوة | 5 |

متعلقات الاعادات کی اہمیت وفضائل، کسان اور اہرار کی افرادی وصلتی کے زیادہ پاس کے اثرات
دین اسلام

اکثرہ مخصوص

ور ہو اسلام کے نظیّہی عقیدہ و عبادات کے بارے میں جان کے واری بیان کر ہے

محوری مقامات:

afa

اشام کے نظیّہی عقیدہ کی ایک بات ہے کہ اسلام کے نظیّہی عقیدہ کے انسان کی تعلیمی اور اجتماعی زندگی کو بہتر بنانے کے لئے عبادات اور عبادات کافی بہتر ہیں۔

عبادات (نماز، زکاہ، زکوۃ) کے ذریے انسانیت اور انسانی زندگی پر اثرات بیان کرے۔

اسلامی عبادات اور عبادات کے طریقے کی زندگی کے سال کا کمی انسان کو بہت مفید ہے۔
اصابات اخلاءات

صabilidad اخلاءات

Gen III

مصروفات

اصابات كامنة/اعطاف

اصابات كامنة (قانون عمل الياكي كتب)

مندرجات اخلاءات كوضحة

رائحة رائكة

رائحة دودة

قروح ورضع

ردت过去

صرورة 건실

وصحة حمدي

وقت قلق

وقال

لاحال

اختار

ياقين اجرام

محليين
نصاب اطلاعیہ سال اول

تاریخ مطابق

الکترونیکی موجودہ سال کا ایک اور اہم کردار ہے۔

خاصیّت مطابق طالب علم اس کا تذکرہ کریں کہ

- موہوم کا مطلب بیان کرکے
- سکی میں یہ سخاوت کے خاصیّت کا کرکے
- ان صیفیت اور غلاف سے پہلے موہوم کے چھفتانہ اثرات پیدا کرنا کے لئے
- دائرة داری کی اطلاع بیان کر کے
- وقای داری کی اطلاع بیان کر کے
- نظام و فنی الافادہ بیان کر کے
- ضرورت بیان کی ضرورت بیان کر کے
- خصوصی بیان کی خصوصی بیان کر کے
- وقت کی پیشانی کے نوازندہ بیان کر
- صرف قسمی بیان کے سنس کا کودکو بیان کر
- خصوصی کے نوازندہ بیان کر کے
نصب اغذیات سال اول

درسی متقابل

ویرایش اغذیات کلیه تری در میل جدید را فراهم کرده‌اند.

خصوصی مقاومان طالب علم از تمرین یادگیری:

1. محدود کردن کاغذ میل بسیار کند.
2. اغلبی از طالب‌های میل کننده میل کنند.
3. دانش‌آموختگان دانشجوی میل کنند.
4. میل گرفتن دانشجوی میل کنند.
5. دانشجویان میل کنند.
6. دانشجویان میل کنند.
7. دانشجویان میل کنند.
8. دانشجویان میل کنند.
9. دانشجویان میل کنند.
10. دانشجویان میل کنند.

منبع این متن: کتاب مهندسی شیمی و مهندسی مواد
خاطفے پاکستان

حصروار

ندروستی مقاعد-حربی قرار

علمی تعقید-طالب علم میں پاکستان کے اسلام میں آزادی تحریک کے کام کا انحصار

خصوصی مقاعد:

- حربی نگار کے ذریعہ پاکستان کے
- آزادی تحریک کے ذریعہ پاکستان کے
- خصوصی اسلام میں آزادی اطلاعہ اور پاکستان کے بیان کے
- دفاع نذاق سے جمعیت پاکستان کے بیان کے
- جسی نذاق کے ذریعہ جماعت پاکستان کے

نظریہ پاکستان

نوری مقاعد-نظریہ پاکستان (دنیہ اسلام) کے دوری طرح وارفہ میں،

خصوصی مقاعد:

نظریہ تحریک میں پاکستان کے اوراس کے دفاع کے

نظریہ پاکستان کے تحریک کے اوراس کے دفاع کے

علما اور نوری مقاعد کے ذریعہ جماعت پاکستان کے

نظریہ پاکستان کا تاریخی پہلو

نوری مقاعد-نظریہ پاکستان کے تاریخی پہلو کا ذریعہ دفاع کے

خصوصی مقاعد-نوری مقاعد کے بارے میں پاکستان کے
نصاب حالی
خضرمود متعلقہ پاکستان

مولویت

طرفی تقریب
پاکستان کی تاریخ میں سلمان اور سیاسی اور اجتماعی نظریات پاکستان کی تاریخ میں استعمال ہے۔ پاکستان کو وضاحت بنانے کے لئے، پاکستان پر نظریہ پاکستان کا تنازع ہے۔

نوع مختلف نظریات کے بعد، پاکستان کا تنازع بحث ہے۔

ہیں کہ ایک مقدمہ کے مطابق، جو اورشالیم اور اشکول الیکٹریکل جماعت کے خدمات، سیاح تھے اور شہری تھے کہ کسی بھی کھیلوں کے

طبیعت کا تنازع

یہ طبیعت کا تنازع ہے کہ پاکستان کی تاریخ میں استعمال ہے۔ پاکستان کا تنازع بحث ہے۔

تاریخ کے بعد، پاکستان کا تنازع بحث ہے۔

مخصوص مکمل

یہ مشقہ کی تنازع ہے کہ سیاح تھے اور شہری تھے کہ کسی بھی کھیلوں کے

تاریخ میں استعمال ہے۔ پاکستان کا تنازع بحث ہے۔

تاریخ میں استعمال ہے۔ پاکستان کا تنازع بحث ہے۔

مخصوص مکمل

یہ مشقہ کی تنازع ہے کہ سیاح تھے اور شہری تھے کہ کسی بھی کھیلوں کے

تاریخ میں استعمال ہے۔ پاکستان کا تنازع بحث ہے۔

تاریخ میں استعمال ہے۔ پاکستان کا تنازع بحث ہے۔

مخصوص مکمل

یہ مشقہ کی تنازع ہے کہ سیاح تھے اور شہری تھے کہ کسی بھی کھیلوں کے

تاریخ میں استعمال ہے۔ پاکستان کا تنازع بحث ہے۔

تاریخ میں استعمال ہے۔ پاکستان کا تنازع بحث ہے۔

مخصوص مکمل

یہ مشقہ کی تنازع ہے کہ سیاح تھے اور شہری تھے کہ کسی بھی کھیلوں کے

تاریخ میں استعمال ہے۔ پاکستان کا تنازع بحث ہے۔

تاریخ میں استعمال ہے۔ پاکستان کا تنازع بحث ہے۔
Eng-112 ENGLISH

Total contact hours
Theory  64   T  P  C
Practical  0   2  0  2

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.

COURSE CONTENTS

ENGLISH PAPER "A"

1. PROSE/TEXT 16 hrs.
   1.1 First eight essays of Intermediate. English Book-II

2. CLOZE TEST 04 hrs.
   1.2 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 word 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.

ENGLISH PAPER "B"

3. GRAMMAR 26 hrs
   3.1 Sentence Structure.
   3.2 Tenses.
   3.3 Parts of speech.
   3.4 Punctuation,
   3.5 Change of Narration.
   3.6 One word for several
   3.7 Words often confused

4. COMPOSITION 8 hrs
   4.1 Letters/Messages
   4.2 Job application letter
   4.3 For 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 hrs
   5.1 Translation from Urdu into English.
   For Foreign Students: A paragraph or a dialogue.

RECOMMENDED BOOKS
1. Technical English developed by Mr. Zia Sarwar, Mr. Habib-ur –Rehman, Evaluated by Mr. Zafar Iqbal Khokhar, Mr. Zahid Zahoor, Vol - I, National Book Foundation
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**

Total contact hours  96  
Theory  3  0  3

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

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

1. Solve problems of Algebra, Trigonometry, vectors, Menstruation, 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.

**COURSE CONTENTS**

1  **QUADRATIC EQUATIONS**  6

Hrs  
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**  3Hrs  

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**  3Hrs  

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

Hrs  
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

5  **PARTIAL FRACTIONS**  6

Hrs  
5.1 Introduction
5.2 Linear Distinct Factors  Case I
5.3 Linear Repeated Factors  Case II
5.4 Quadratic Distinct Factors  Case III
5.5 Quadratic Repeated Factors  Case IV
5.6 Problems

6  FUNDAMENTALS OF TRIGONOMETRY  6
Hrs
6.1 Angles
6.2 Quadrants
6.3 Measurements of Angles
6.4 Relation between Sexagesimal & circular system
6.5 Relation between Length of a Circular Arc & the Radian Measure of its central Angle
6.6 Problems

7  TRIGONOMETRIC FUNCTIONS AND RATIOS  6
Hrs
7.1 trigonometric functions of any angle
7.2 Signs of trigonometric Functions
7.3 Trigonometric Ratios of particular Angles
7.4 Fundamental Identities
7.5 Problems

8  GENERAL IDENTITIES  6
Hrs
8.1 The Fundamental Law
8.2 Deductions
8.3 Sum & Difference Formulae
8.4 Double Angle Identities
8.5 Half Angle Identities
8.6 Conversion of sum or difference to products
8.7 Problems

9  SOLUTION OF TRIANGLES  6
Hrs
9.1 The law of Sines
9.2 The law of Cosines
9.3 Measurement of Heights & Distances
9.4 Problems

10  MENSURATION OF SOLIDS  30
Hrs
10.1 Review of regular plane figures and Simpson's Rule
10.2 Prisms
10.3 Cylinders
10.4 Pyramids
10.5 Cones
10.6 Frusta
10.7 Spheres

11  VECTORS  9
Hrs
11.1 Sealers & Vectors
11.2 Addition & Subtraction
11.3 The unit Vectors \( \mathbf{i}, \mathbf{j}, \mathbf{k} \)
11.4 Direction Cosines
11.5 Sealer or Dot Product
11.6 Deductions
11.7 Dot product in terms of orthogonal components
11.8 Deductions
11.9 Analytic Expression for \( \mathbf{a} \times \mathbf{b} \).
11.10 Problems.

12 MATRICES AND DETERMINANTS

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<thead>
<tr>
<th>Hrs</th>
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<tr>
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<td>12.2</td>
<td>Rows &amp; Columns</td>
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<td>Algebra of Matrices</td>
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<td>Properties of Determinants</td>
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<td>12.7</td>
<td>Solution of Linear Equations</td>
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<tr>
<td>12.8</td>
<td>Problems</td>
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</tbody>
</table>

REFERENCE BOOKS
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 discriminant
   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: \( \binom{n}{0}, \binom{n}{1}, \ldots, \binom{n}{r}, \ldots, \binom{n}{n} \)
   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 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 MENSTRUATION IN FINDING SURFACES, VOLUME AND WEIGHTS OF SOLIDS.
10.1 Define menstruation 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

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 vector.
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.
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<table>
<thead>
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<tbody>
<tr>
<td>12.5</td>
<td>Explain basic concepts.</td>
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<tr>
<td>12.6</td>
<td>Explain algebra of matrices.</td>
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<tr>
<td>12.7</td>
<td>Solve linear equation by matrices.</td>
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<tr>
<td>12.8</td>
<td>Explain the solution of a determinant.</td>
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<tr>
<td>12.9</td>
<td>Use Crammers Rule for solving linear equations</td>
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</tbody>
</table>
PHY – 124  APPLIED PHYSICS

Total Contact Hours  160  
Theory  64 hours  T  P  C  2  3  3  
Practical  96 hours

COURSE AIMS:

The student will be able to understand the fundamental principles and concept of Physics. Use these to solve problems in practical situations / technological course and understand concepts to learn advance physics / technical course.

COURSE CONTENTS

1. MEASUREMENT  5 Hours

   Fundamental units and derived units
   Systems of measurement and S.I units
   Concepts of dimensions, dimensional formula
   Conversion from one system to another
   Significant figures

2. SCALARS AND VECTORS  4 Hours

   Revision of head to tail rule
   Laws of parallelogram, triangle and polygon of forces
   Resolution of a vector
   Addition of vectors by rectangular components
   Multiplication of two vectors, dot product and cross product

3. MOTION  5 Hours

   Review of laws and equation of motion
   Laws of conservation of momentum
   Angular motion
   Relation between linear and angular motion
   Centripetal acceleration and force
   Equation of angular motion

4. TORQUE, EQUILIBRIUM AND ROTATIONAL INERTIA  5 Hours

   Center of gravity and center of mass
Equilibrium and its conditions
Torque and angular acceleration
Rotational inertia

5. WAVE MOTION 5 Hours
   Review Hook’s Law of elasticity
   Motion under an elastic restoring force
   Characteristics of harmonic motion
   S.H.M and circular motion
   Simple pendulum
   Wave form of S.H.M
   Resonance
   Transverse vibration of a stretched string

6. LIGHT 5 Hours
   Review laws of refraction and refraction
   Image formation by mirrors and lenses
   Optical instruments
   Interference, diffraction, polarization of light waves

7. LASERS 5 Hours
   Corpuscular theory of light
   Emission and absorption of light
   Stimulated absorption and emission of light
   Laser principle
   Structure and working of lasers
   Types of lasers with brief description
   Applications of basic concepts
   Material processing
   Laser welding
   Laser assisted machining
   Micro machining
   Drilling, scribing and marking
8. **HEAT**  
Review of calorimetric and gas laws  
Thermal expansion of solids, liquids and gases  
Heat of fusion, vaporization  
Humidity, absolute and relative  
Law of cooling  
Thermoelectricity  
Thermocouple  

9. **THERMODYNAMICS**  
Heat energy and internal energy  
First law of thermodynamics  
Isometric and adiabatic processes  
Efficiency of heat engine  
Second law of thermodynamic (both statement)  
Heat engine and refrigerator  

10. **TRANSFER OF HEAT**  
Review: modes of transfer of heat  
Emission and absorption of heat  
Black body radiation  
Laws of energy distribution  
Planck’s Quantum Theory  
The photoelectric effect  
X-rays, production, properties and uses  

11. **ATOMIC NUCLEUS**  
Structure of the nucleus  
Radioactivity  
Radioactive series  
Transmutation of elements  
The fission reaction  
The fusion reaction
12. **NUCLEAR RADIATIONS** 5 Hours
   - Properties and interaction with matter
   - Radiation detectors
   - Radiation damage and its effects
   - Radiation therapy
   - Radioactive tracers

13. **MAGNETIC & SEMI CONDUCTOR MATERIALS** 5 Hours
   - Magnetism
   - Domains theory
   - Para, dia and ferromagnetism and magnetic materials
   - Crystalline structure of solids
   - Conductors, semiconductors, insulators
INSTRUCTIONAL OBJECTIVES

1. **USE CONCEPTS OF MEASUREMENT TO PRACTICAL SITUATIONS AND TECHNOLOGICAL PROBLEMS**
   - Write dimensional formulae for physical quantities
   - Derive units using dimensional equations
   - Convert a measurement from one system to another
   - Use concepts of measurement and significant figures in problems solving

2. **USE CONCEPTS OF SCALARS AND VECTORS IN SOLVING PROBLEMS INVOLVING THESE CONCEPTS**
   - Explain laws of parallelogram, triangle and polygon of force
   - Describe method of resolution of a vector into components
   - Describe method of addition of vectors by rectangular components
   - Differentiate between dot product and cross product of vectors
   - Use the concepts 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**
   - Use law of conservation of momentum practical / technological problems
   - Explain relation between linear and angular motion
   - Use concepts and equations of angular motion to solve relevant technological problems

4. **USE CONCEPTS OF TORQUE, EQUILIBRIUM AND ROTATIONAL INERTIA TO PRACTICAL SITUATION / PROBLEMS**
   - Distinguish between center of gravity and center of mass
   - Explain rotational equilibrium and use conditions
   - Explain rotational inertia giving examples
   - Use the above concepts in solving technological problems

5. **USE CONCEPTS OF WAVE MOTION IN SOLVING RELEVANT PROBLEMS**
   - Explain Hook’s law of elasticity
   - Derive formula for motion under an elastic restoring force
   - Derive formula for simple harmonic motion and simple pendulum
Explain wave form with reference to S.H.M and circular motion
Explain resonance
Explain transverse vibration of a stretched string
Use the above concepts and formula of S.H.M to solve relevant problems

6. USE THE CONCEPTS OF GEOMETRICAL OPTICS TO MIRRORS AND LENSES
Explain laws of reflection and refraction
Use mirror formula to solve problems
Use the concepts of image formation by mirrors and lenses to describe working of optical instruments, e.g. microscope, telescope, camera and sextant

7. UNDERSTAND THE STRUCTURE, WORKING AND USES OF LASERS
Explain the stimulated emission of radiation
Explain the laser principle
Describe the structure and working of lasers
Distinguish between types of lasers
Describe the applications of lasers

8. UNDERSTAND CONCEPTS OF HEAT
Explain calorimetric
Explain gas laws giving mathematical expressions
Explain thermal expansion of solids, liquids and gases
Distinguish between heat of fusion, vaporization
Distinguish between absolute and relative humidity
Describe laws of cooling
Explain basic concepts of thermoelectricity
Describe thermocouple, giving its principle, structure and working

9. UNDERSTAND LAWS OF THERMODYNAMICS
Distinguish between heat energy and internal energy
Explain first law of thermodynamics giving its applications
Distinguish between isometric and adiabatic processes
Explain second law of thermodynamics describing alternate statements
Distinguish between work of heat engine and refrigerator.
10. UNDERSTAND LAWS OF ENERGY DISTRIBUTION AND EMISSION OF RADIATION
   Explain modes of transfer of heat
   Explain back body radiation and laws of energy distribution
   Describe Planck’s Quantum Theory
   Explain photoelectric effect
   Explain production, properties and uses of X-rays.

11. UNDERSTAND THE STRUCTURE OF THE ATOMIC NUCLEUS AND RELEVANT ACTIVITIES
   Describe the structure of the nucleus
   Explain radioactivity and radioactive series
   Explain transmutation of elements
   Distinguish between fission reaction and fusion reaction

12. UNDERSTAND NUCLEAR RADIATIONS THEIR EFFECTS AND USES
   Describe properties of nuclear radiations and their interaction with matter
   Explain working of radiation detectors
   Explain damaging effects of nuclear radiations
   Explain radiation therapy
   Describe radioactive tracers
   Describe applications of radiation techniques in course contents

13. UNDERSTAND BASIC CONCEPTS CLASSIFICATION OF MAGNETIC MATERIALS
   Explain domains theory of magnetism
   Distinguish between Para, dia and ferromagnetic and magnetic materials
   Distinguish between B and H
LIST OF PRACTICAL

1. Draw graphs representing the functions $Y = mx$ for $m = 0, 0.5, 1, 2$
   $Y = x^2$
   $Y = 1 / x$

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 Fletcher's trolley

5. Verify law of parallelogram of force using Grave sands apparatus

6. Verify law of triangle of forces and Lami's theorem

7. Determine the weight of a given body using
   Law of parallelogram of forces
   Law of triangle of forces
   Lami's theorem

8. Verify law of polygon of forces using Grave sands apparatus

9. Locate the positions 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 principles of moments

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

13. Find young's modules of elasticity of a metallic wire

14. Verify Hook's law using helical spring

15. Study of frequency of stretched string with length

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

17. Study of resonance of air column in resonance tube and flinging 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 lens
26. Find refractive index of glass by spectrometer
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 simple 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 expansion of a metallic rod
40. Find the heat of fusion of ice
41. Find the heat of vaporization
42. Determine relative humidity using hygrometer
CH – 112       APPLIED CHEMISTRY

Total Contact Hours      128       T      P      C
Theory                  32 hours   1      3      2
Practical               96 hours

Pre-requisites: The student must have studied the subject of elective chemistry at secondary school level.

COURSE AIMS:

After studying this course a student will be able to:
1. Understand the significance and role of chemistry in the development of modern technology
2. Become acquired with the basic principles of chemistry as applied in the study of relevant technology.
4. Gains skill for the efficient conduct of practical in a chemistry lab.

COURSE CONTENTS

1. INTRODUCTION AND FUNDAMENTAL CONCEPTS          2 Hours
Orientation with reference to this technology
Terms used & units of measurements in the study of chemistry
Chemical reactions & their types

2. ATOMIC STRUCTURE               2 Hours
Sub atomic particles
Architecture of atoms of elements. Atomic no. & atomic weight
The periodic classification of elements periodic law
    General characteristics of a period and group

3. CHEMICAL BOND                  2 Hours
Nature of chemical bond
Electrovalent bond with examples
Covalent bond (polar and non-polar, sigma & pie bonds with examples) Co-
ordinate bond with examples
4. **WATER**  
   2 Hours
   Chemical nature and properties  
   Impurities  
   Hardness of water (types, causes and removal)  
   Scales of measuring hardness (degrees clark French, PPM, Mg- per liter)  
   Boiler feed water, scales and treatment  
   Sea water desalination, sewage treatment

5. **ACIDS, BASES AND SALTS**  
   2 Hours
   Definitions with examples  
   Properties, their strength, basicity and acidity  
   Salts and their classification with examples  
   Ph – value and scale

6. **OXIDATION & REDUCTION**  
   2 Hours
   The process, definition and examples  
   Oxidizing and reducing agents  
   Oxides and their classifications

7. **NUCLEAR CHEMISTRY**  
   2 Hours
   Introduction  
   Radioactivity (alpha, beta and gamma rays)  
   Half life process  
   Nuclear reaction and transformation of elements

8. **CEMENT**  
   2 Hours
   Introduction  
   Composition and manufacture  
   Chemistry of setting and hardening  
   Special purpose cements

9. **GLASS**  
   2 Hours
   Composition and raw material  
   Manufacture  
   Varieties and uses
10. PLASTICS AND POLYMERS 2 Hours
Introduction and importance
Classification
Manufacture
Properties and uses

11. PAINTS, VARNISHES AND DISTEMPER 2 Hours
Introduction
Constituents
Preparation and use

12. CORROSION 2 Hours
Introduction with causes
Types of corrosion
Rusting of iron
Protective measures against corrosion

13. REFRACTORY MATERIALS AND ABRASIVE 2 Hours
Introduction to refractories
Classification of refractories
Properties and uses
Introduction to abrasives
Artificial and natural abrasives and their uses

14. ALLOYS 2 Hours
Introduction with need
Preparation and properties
Some important alloys and their composition
Uses

15. FUELS AND COMBUSTION 2 Hours
Introduction of fuels
Classification of fuels
Combustion
Numerical problems of combustion
16.  LUBRICANTS  
Introduction
Classification
Properties of lubricants
Selection of lubricants

17.  POLLUTION  
The problems and its dangers
Causes of pollution
Remedies to combat the hazards of pollution
INSTRUCTIONAL OBJECTIVES

1. UNDERSTAND THE SCOPE, SIGNIFICANCE AND FUNDAMENTAL ROLE OF THE SUBJECT
Define chemistry and its important terms
State the units of measurements in the study of chemistry
Write chemical formula of common compounds
Describe types of chemical reactions with examples

2. UNDERSTAND THE STRUCTURE OF ATOMS AND ARRANGEMENT OF SUB ATOMIC PARTICLES IN THE ARCHITECTURE OF ATOMS
Define atom
State the periodic law of elements
Describe the fundamentals sub atomic particles
Distinguish between atomic no. And mass no. Isotopes and isobars
Explain the arrangements of electrons in different shells and sub energy levels
Explain the grouping and placing of elements in the periodic table

3. UNDERSTAND THE NATURE OF CHEMICAL BOND
Define chemical bond
Describe the nature of chemical bond
Differentiate between electrovalent and covalent bonding
Explain the formation of polar and non polar, sigma and pi-bond with examples
Describe the nature of coordinate bond with examples

4. UNDERSTAND THE CHEMICAL NATURE OF WATER
Describe the chemical nature of water with its formula
Describe the general impurities present in water
Explain the causes and methods to removing hardness of water
Express hardness in different units like mg / liter, p.p.m, degrees Clark and degrees French
Describe the formation and nature of scales in boiler feed water
Explain the method for the treatment of scales
Explain the sewage treatment and desalination of sea water
5. UNDERSTAND THE NATURE OF ACIDS, BASES AND SALTS
Define acids, bases and salts with examples
State general properties of acids and bases
Differentiate between acidity and basicity and use the related terms
Define salts, state their classification with examples
Explain p-h value of solution and pH-scale

6. UNDERSTAND THE PROGRESS OF OXIDATION AND REDUCTION
Define oxidation
Explain the oxidation process with examples
Define reduction
Explain reduction process with examples
Define oxidizing and reducing agents and give at least six examples of each
Define oxides
Classify the oxides and give examples

7. UNDERSTAND THE FUNDAMENTALS OF NUCLEAR CHEMISTRY
Define nuclear chemistry and radio activity
Differentiate between alpha, beta and gamma particles
Explain half life process
Explain at least six nuclear reactions resulting in the transformation of some elements
State important uses of isotopes

8. UNDERSTAND THE MANUFACTURE, SETTING AND HARDENING OF CEMENT
Define Portland cement and give its composition
Describe the method of manufacture
Describe the chemistry of setting and hardening of cement
Distinguish between ordinary and special purpose cement
9. **UNDERSTAND THE PROCESS OF MANUFACTURE OF GLASS**
   - Define glass
   - Describe its composition and raw materials
   - Describe the manufacture of glass
   - Explain its varieties and uses

10. **UNDERSTAND THE NATURE AND IMPORTANCE OF PLASTIC AND POLYMERS**
    - Define plastics and polymers
    - Explain the mechanism of polymerization
    - Describe the preparation and uses of some plastic / polymers

11. **KNOW THE CHEMISTRY OF PAINTS, VARNISHES AND DISTEMPERS**
    - Define paints, varnishes and distemper
    - State composition of each
    - State methods of preparation of each and their uses

12. **UNDERSTAND THE PROCESS OF CORROSION WITH ITS CAUSES AND TYPES**
    - Define corrosion
    - Describe different types of corrosion. State the causes of corrosion
    - Explain the process of rusting of iron
    - Describe methods to prevent / control corrosion

13. **UNDERSTAND THE NATURE OF REFRACTORY MATERIALS ABRASIVE**
    - Define refractory materials
    - Classify refractory materials
    - Describe properties and uses of refractory
    - Define abrasive
    - Classify natural and artificial abrasives
    - Describe uses of abrasives

14. **UNDERSTAND THE NATURE AND IMPORTANCE OF ALLOYS**
    - Define alloy
    - Describe different methods for the preparation of alloys
    - Describe important properties of alloys
    - Enlist some important alloys with their composition, properties and uses
15. **UNDERSTAND THE NATURE OF FUELS AND THEIR COMBUSTION**
   
   Define fuels
   
   Classify fuels and make distinction of solid, liquid and gaseous fuels
   
   Describe important fuels
   
   Explain combustion
   
   Calculate air quantities in combustion gases

16. **UNDERSTAND THE NATURE OF LUBRICANTS**
   
   Define a lubricant
   
   Explain the uses of lubricants
   
   Classify lubricants and site examples
   
   State important properties of oils, greases and solid lubricants
   
   State the criteria for the selection of lubricant for particular purpose / job

17. **UNDERSTAND THE NATURE OF POLLUTION**
   
   Define pollution (air, water, food)
   
   Describe the causes of environmental pollution
   
   Enlist some common pollutants
   
   Explain methods to prevent pollution
LIST OF PRACTICAL:
1. Salt analysis
2. Acidic radicals
3. Dilute acid group
4. Concentrated acid group
5. Special group
6. Basic radicals
7. 1st group radicals
8. 2nd group radicals
   a. 2nd A
   b. 2nd B
9. 3rd group radicals
10. 4th group radicals
11. 5th group radicals
12. 6th group radicals
13. Analytical balance weighing techniques
14. Separation or salts by
   a. Sublimation process
   b. Filtration process
   c. Sedimentation process
15. Practical note book
16. Salt analysis scheme

RECOMMENDED BOOKS
1. Text Book of intermediate Chemistry (I & II)
2. Ilmi Applied Science by Sh. Atta Muhammad
3. Polytechnic Chemistry by J.N. Reedy Tata Mcgraw Hill (New Dehli)
4. Chemistry for Engineers by P.C. Jain (New Delhi, India)
**COMP – 122  COMPUTER APPLICATIONS**

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<td>Total Contact Hours</td>
<td>128</td>
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<tr>
<td>Theory</td>
<td>32 hours</td>
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<tr>
<td>Practical</td>
<td>96 hours</td>
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**COURSE AIMS:**

This subject will enable the student to be familiar with the operation of a Microcomputer. He will also learn DOS, BASIC language and word processing to elementary level.

**COURSE CONTENTS**

1. **ELECTRONIC DATA PROCESSING** 6 Hours
   - Basics of computers
   - Classification of computers
   - Block diagram of a computer system
   - Binary number system
   - BIT, BYTE, RAM, ROM, EROM, EPROM
   - Input and output devices
   - Secondary storage media details
   - Processors and types
   - Using computer for system software
   - Using computers for application software
   - Common types of software and their application

2. **DISK OPERATING SYSTEM (DOS)** 6 Hours
   - Internal commands
   - External commands
   - Batch files
   - Advance features

3. **BASIC LANGUAGE** 10 Hours
   - Introduction to high level language
   - Introduction to BASIC
   - REM statement
   - Assignment statement
Input statement
Read data statement
If-then statement
If-then else statement
For next statement
DIM statement
L print statement
STOP statement
END statement
Logic of a BASIC programme
Running a BASIC programme
Saving and retrieving a programme
Advance features

4. WORD PROCESSING 7 Hours
Starting word processor session
Opening a document
Saving a document
Ending word processor session (temporarily)
Retrieving a document
Spell check
Margins and tab setting
Aligning paragraph
Printing a document
Advance features

5. COMPUTER GRAPHIC IN BASIC 3 Hours
Graphic fundamentals
Points and lines
Dots in space
A lightening blot
Shapes
Expanding circles and rectangles
RECOMMENDED BOOKS

1. Ron. S. Gottfrid, Programming with BASIC
2. Any word Processor Latest Released (e.g. Word, Word Perfect etc.)
3. ABC’s of DOS (latest release)
4. Judd Robbins, Mastering DOS 6.0 and 6.2
INSTRUCTIONAL OBJECTIVES

1. UNDERSTAND ELECTRONIC DATA PROCESSING (EDP)
   Know basics of computers
   Know classification of computers
   Know block diagram of a computer system
   Know binary number system
   Know some general terms used in computers
   Know input and output devices
   Know secondary storage media
   Explain processor and its types
   Know the use of computer for system software
   Know use of computers for application software
   Explain commonly used application of software

2. UNDERSTAND RISK OPERATING SYSTEM (DOS)
   Know internal command of DOS
   Know external commands of DOS
   Describe batch files
   Identify advanced features

3. UNDERSTAND BASIC LANGUAGE
   Explain high level languages
   Explain basic languages
   Describe ram statement
   Describe assignment statement
   Explain input statement
   Explain Read-Data statement
   Explain If-then statement
   Explain if-then else statement
   Explain for next statement
   Explain DIM statement
Explain LPRINT statement
Explain STOP statement
Explain END statement
Describe logic of basic program
Describe running a basic program
Describe saving and retrieving basic program
Describe some advance features of basic program

4. UNDERSTAND WORD PROCESSING SESSION

Describe word processing
Name command to be entered on DOS prompt to load word processor
Identify initial screen
Describe the command to open a document
Describe the procedure for naming the document
Explain importance of giving extension to a document
Describe saving and retrieving a document
Explain importance of saving the work at regular intervals
State temporary ending word processing session and document retrieval
State procedure to re-enter word processor
State procedure to re-open the document and editing
Describe spell check facility
Describe margins and tab setting
Describe to align paragraph
Describe re-editing techniques
Describe procedure to set up printer
Describe command for print outs
Explain multiple copy print out procedure
Explain some advance features
Describe procedure of condensed printing
Describe procedure for change of fonts
5. UNDERSTAND PROGRAMMING INSTRUCTIONS FOR COMPUTER GRAPHIC IN BASIC LANGUAGE

Identify graphic fundamentals in basic language

Draw points and lines

Draw dot in space

Draw lighting blot

Draw shapes

Draw expanding circles and rectangles

LIST OF PRACTICAL

DOS
1. Identify key board, mouse, CPU, disk drives, disks, monitor & printer
2. Practice for booting up of a computer system with DOS system disk and power off system at DOS prompt
3. Practice for CLS, VER, VOL, DATE & TIME commands
4. Practice for COPY, REN commands
5. Practice for DEL, TYPE, PATH, PROMPT, COPY CON, MD, CD, RD commands
6. Practice of the practical at Sr. No. 3, 4, 5.
7. Practice for FORMAT command with /s, /4, /u switches
8. Practice for DISKCOPY, DISKCOMP commands
9. Practice for PRINT, UNDELETE commands
10. Practice for the practical at Sr. No. 8, 9, 10, 11
11. Practice for creating a batch file

BASIC
1. Practice for loading & unloading BASIC software and identify role of function keys in basic.
2. Identify role of various keys in continuation with ALT keys in BASIC programming
3. Practice for CLS, LOAD, SVE, FILE, RENUM command by loading any existing BASIC program
4. Practice for editing any existing BASIC program
5. Prepare BASIC program to display sum of two numbers using INPUTS
6. Prepare BASIC program to display sum of two numbers using READ-DATA
7. Prepare BASIC program to multiply two numbers
8. Prepare BASIC program to calculate area of rectangle, when length and width are given
9. Prepare BASIC program to calculate area of circle when radius / diameter is given
10. Prepare very simple BASIC programs using IF-THEN-ELSE and FOR-NEXT statement
11. Identify DIM statement
12. Practice for LPRINT statement for various programs hard copy output

**Word Processing**

1. Practice for loading & unloading a word processor
2. Practice for creating document & saving it
3. Practice for spell check facility of the word processor
4. Practice for editing and existing document
5. Practice for various word processing menu options
6. Practice for margin and TAP setting and document alignment
7. Practice for some advance features
COURSE AIMS:

The student will be able to understand the fundamental principles and concept in Chemical Engineering and apply them to solve the problems in practical situations and in evaluation of the direction for further development in the process.

COURSE CONTENTS

1. **UNITS AND DIMENSIONS** 8 Hours

   Primary and secondary quantities
   Dimensions of secondary quantities
   System of measurement
   Units and their conversion
   Conversion of units of following quantities into English / Metric system
   Pressure
   Viscosity
   Density
   Force
   Energy
   Work
   Gas constant
   Dimensional and dimension less formula.

2. **GRAPH, TYPES OF GRAPH** 8 Hours

   Drawing simple graph

3. **PRODUCTION OF LOW TEMPERATURE BY REFRIGERATION** 8 Hours

   Definition, methods of refrigeration
   Refrigerant and their properties
   Application of refrigeration
Schematic diagram of refrigeration
Working principles of refrigerator

4. PIPE AND TUBES 8 Hours
Types of pipes
Cast iron pipe, wrought iron pipe, steel pipe aluminum pipes, plastic
Pipe standards
Pipe fitting
Types of valves
Construction: working and application of gate valve

5. STEAM TRAP AND THEIR TYPES 8 Hours
Bucket trap, expansion trap, inverted bucket trap, impulse trap

6. THERMAL INSULATION 8 Hours
Insulation material, properties and uses
Insulation techniques for stream pipes and vessels
Insulation techniques for low temperature pipes

7. SYMBOLS 4 Hours
Symbols for fitting
Symbols for equipments

8. PETROLEUM TESTS 8 Hours
Flash point, aniline point pour point, cloud point, diesel index,
Sedimentation number
Octane number

9. INTRODUCTION TO PHOTOCOPYING 4 Hours
INSTRUCTIONAL OBJECTIVES

1. UNITS AND DIMENSION

The student will know the primary and secondary quantities
Define primary quantity and secondary quantity
Give examples of primary quantities and secondary quantities
Understand dimensions of secondary quantities
Explain the secondary quantities in terms of primary quantities
Write the dimension of secondary quantities
Understand the systems of measurement
Name different systems of measurement
Name basic quantities of each system
Develop dimensions of derived quantities in each system
Understand units and their conversions
Developed units to measure the derive quantities in different systems
Define different units used
Convert the units of one system into the other system
Understand dimensional and dimensional formula
Differentiate between dimensional formula and dimensionless formula
Check the dimension of and engineering formula. Like;
Reynolds number potential energy. Kinetic energy

2. GRAPH

Understand the concept of graph
Define graph
Explain the types of graph
Give comparison between tabular and graphic representation of data
Understand the method of drawing to draw a graph
Explain the steps necessary to draw a graph
Draw a simple graph
Note the end point from a graph
Take reading from a graph
Make extrapolation and interpolation on a graph
3. PRODUCTION OF LOW TEMPERATURE BY REFRIGERATION

Know the methods of refrigeration
Define the refrigeration
Name the different methods of refrigeration based on the refrigeration used
Compare different methods of refrigeration
Understand the refrigeration and their properties
Define the refrigeration
Name different refrigerants used in the field
Enlist the properties of a good refrigerant
Understand the application of refrigeration
Give domestic application of refrigeration
Give industrial application of refrigeration
Understand schematic diagram of refrigeration
Draw a schematic diagram of refrigeration
Explain the function of each component in the diagram
Understand working principles of refrigeration
Explain working principles of single fluid refrigerator
Explain working principles of two fluid refrigerator

4. PIPES AND TUBES

Know the types of pipes
Enlist the types of pipes used by chemical industries
Give the field of applications of different types of pipes used
Give characteristics of different types of pipes used by chemical engineer
Apply the pipe standards
Understand the concept of schedule nos used for pipe
Select the schedule no according to the pipe duty (pressure)
Understand pipe fitting
Define pipe fitting
Enlist the different pipe fitting used
Explain the functions of different pipe fitting used in chemical industries
Know the types of valves
Define valve
Enlist the types of valves
Understand construction and working of valves
Explain the construction and working of gate value
Explain the construction and working of globe value
Explain the construction and working of ball value
Select a proper valve according to need

5. STEAM TRAP
Know the steam trap
Explain the function of steam trap
Enlist the types of steam traps
Understand different types of traps
Explain the construction and working of bucket trap
Explain the construction and working of inverted bucket trap
Explain the construction and working of expansion trap
Explain the construction and working of impulse trap

6. THERMAL INSULATION
Understand insulating materials, properties and uses
Define thermal insulation
Explain the need of thermal insulation
Enlist the insulating materials used in chemical industry
Enlist the properties of a good insulating materials
Apply the insulation techniques for steam pipes and valves
Explain the method of steam pipe insulation (lagging)
Calculate the thickness of insulation layer on steam pipe by using the formula (q = KADT)
Understand insulation technique for low temperature pipes
Decide the nature of insulation material for low temperature pipes
Explain the method of pipe insulation

7. SYMBOLS
Understand symbols of fittings
Read symbols of fittings
Draw symbols to represent different fittings
Understand symbols for equipments
Read symbols of equipments
Draw symbols to represent different equipments and vassals of chemical engineering

8. PETROLEUM TEST
Understand different tests of petroleum
Understand the importance of petroleum testing
Define flash point, aniline point pour point and cloud point
Explain procedure to perform above tests for petroleum sample
Define diesels index
Explain procedure to find diesel index
Define sedimentation number
Explain method to note sedimentation no.
Define octane number and octane number determination method

9. INTRODUCTION TO PHOTOCOPYING
Understand the photocopying
Explain the concept of photocopying
Explain the methods of photocopying
Enlist the precautions to be observed while operating a photocopier
LIST OF PRACTICAL

1. Calculation of dimensions of different secondary quantities
2. Determination of units of different quantities in different measuring systems
3. Conversion of units in different systems
4. Drawing of simple graph
5. Graph reading
7. Pipe cutting
8. Pipe threading
9. Pipe fittings
10. Installation of valves
11. Insulation of steam traps
12. Insulation of steam pipe lines

RECOMMENDED BOOKS:

1. Manual for basic chemical engineering
3. Introduction to chemical engineering by watter L. Bedger and Julims T Bencharo
4. Introduction to chemical engineering by Little John
MT – 143  BASIC ENGINEERING DRAWING & CAD – I

Total Contact Hours  224  
Theory  32 hours  
Practical  192 hours

COURSE AIMS:

At the end of this course the student will be able to understand the fundamentals of engineering drawing used in the various fields of industry especially in the Mechanical Technology. The student will be familiarized with the use of conventional drawing instruments as well as the modern technology used for this subject. The CAD portion of the subject will provide the student the knowledge and use of computer in the subject of Engineering Drawing.

COURSE CONTENTS

SECTION – I  ENGINEERING DRAWING

1. USES AND APPLICATIONS OF TECHNICAL DRAWING  1 Hours
   - Technical drawing and the technician
   - Use of technical drawing
   - Common drawing forms
   - Application of drawing forms
   - Practices and conventions

2. DRAWING TOOLS AND ACCESSORIES  2 Hours
   - Drawing pencil
   - Drawing papers specifications
   - Drawing instruments
   - Use and care of drawing instruments and material

3. ALPHABET OF LINES USED IN DRAWING  2 Hours
   - Importance of the alphabet of lines
   - Common alphabet of lines
   - Uses and correct line weight-age of the line
   - Application of line
4. **LETTERING**  
Importance of good lettering  
Single stroke of gothic  
Letter stroke  
Letter guide lines  
Vertical single stroke gothic  
Inclined single stroke gothic  
Composition of lettering

5. **DRAWING LINES TECHNOLOGY**  
Introduction to sketching techniques  
Sketching lines  
Sketching circles and arcs  
Sketching ellipse  
Sketching views of objects

6. **GEOMETRICAL CONSTRUCTIONS**  
Introduction to geometry  
Definition of terms  
Different conventional shapes, surfaces and objects  
Basic geometrical construction  
Construction, ellipse, parabola  
Involutes and cycloids

7. **INTRODUCTION TO MULTI VIEW PROJECTIONS**  
Definition and concept of multi-view drawings  
Perceptual views of plan of projections  
Orthographic projections  
1\textsuperscript{st} angle and 3\textsuperscript{rd} angle projections  
Principle views  
Arrangement of views  
Multi-view drawings
8. INTRODUCTION TO PICTORIAL DRAWINGS 2 Hours
   Uses of pictorial
   Three types of pictorial views
   Isometric sketching of rectangular block
   Isometric sketching of arcs and circles
   Oblique sketching of rectangular block
   One point perspective sketching of rectangular block
   Two point perspective sketching of a rectangular block
   Preparation of pictorial drawings of simple objects

9. BASIC DIMENSIONING 2 Hours
   Definition of dimensioning
   Types of dimensioning
   Elements of dimensioning
   System of measurements
   Dimensioning multi-view drawings
   Dimensioning pictorial views
   Dimensioning rules and practices
   Notes and specification

10. SECTIONING AND SECTIONAL VIEWS 2 Hours
    Definition and purpose
    Cutting planes position and cutting plane lines
    Types of sectional views
    Conventional section lines of different materials
    Practice sectioned views

11. DRAWING OF MACHINE ELEMENTS 2 Hours
    Terminology and drawing of rivets and riveted joints
    Terminology and drawing of screw threads
    Terminology and drawing of keys and cotters
    Description and drawing of simple bearings
    Describe and drawing of simple coupling
SECTION – II  COMPUTER AIDED DESIGN – I

12. CAD FUNDAMENTALS  2 Hours
    CAD and its importance
    Purposes
    Advantages

13. CAD SOFTWARE  2 Hours
    CAD abbreviations
    CAD help
    Co ordinance systems

14. BORDER TEMPLATE  2 Hours
    Drawing area
    SNAP & GRID
    P edit & Q save

15. TITLE BLOCK  2 Hours
    Change command
    Layer creation
    Zooming
    Types faces of CAD
    Plotting

16. LINES & CIRCLES  2 Hours
    Dedit
    Analyzed line drawing
    U & Redo command
    Drawing a circle
INSTRUCTIONAL OBJECTIVES

1. USES AND APPLICATIONS OF TECHNICAL DRAWING
   Know the uses of technical drawing
   Describe the importance of technical drawing from the point of view of a technician
   Explain the main uses of technical drawing from the point of view of a technician
   Recognizes the different application of technical drawing
   Identity commonly used drawing forms
   Illustrate the different drawing forms
   Differentiate different drawing forms
   Develop technical vocabulary

2. KNOW THE COMMON DRAWING TOOLS AND ACCESSORIES
   Identify the uses of different pencils for technical drawing
   Identify different paper sizes for drawing
   Identify different types of papers suitable for drawing
   Identify different types of erasers and their uses
   Maintain a will sharpened pencil for drawing
   Describe the drawing instruments
   State the use of drawing instruments

3. UNDERSTAND THE IMPORTANCE OF ALPHABET, CORRECT WEIGHT AGE AND APPLICATION OF LINES USES IN TECHNICAL DRAWING
   Knows the importance of lines
   Knows the alphabet of lines
   Identify the lines characteristics of each alphabet of lines
   Draw horizontal, vertical and inclined lines
   Draw alone line with correct weight ages
4. **APPLIES THE GOOD LETTERING ON A DRAWING**

   Knows the importance of lettering in a technical engineering drawing
   
   Identify the letter style and guide lines
   
   State letter strokes and guide lines
   
   Perform better stroke in single stroke gothic
   
   Print vertical single stroke letters and numbers
   
   Print incline single stroke letters and numbers
   
   Observe stability and pleasing appearance of letters in printing

5. **UNDERSTAND SELECTING OF CIRCLES, ARCS AND VIEWS OF OBJECTS**

   Draw circular an arc using circular line method
   
   Draw a circular arc using square method
   
   Draw an ellipse using rectangular method
   
   Draw views of simple objects

6. **APPLY DRAWING SKILL WITH THE AID OF DRAWING INSTRUMENTS IN GEOMETRICAL CONSTRUCTION**

   Define common terms used in geometrical construction
   
   Explain different geometrical shapes. Surface of objects
   
   Draw basic geometrical construction
   
   Draw involutes, cycloid, spiral, and tangent to circle and arc.

7. **UNDERSTAND THE MULTI VIEW OF PROJECTIONS SPECIFIC OBJECTIVES**

   Define the concept of multi view drawings
   
   Knows principles planes of projections
   
   Knows the orthographic method of projection
   
   Explain the 1\textsuperscript{st} and 3\textsuperscript{rd} angle projections
   
   State six principle views
   
   Practice multi view projections

8. **APPLY THE USE, TYPES AND METHODS OF PICTORIAL VIEWS**

   Knows the use of pictorial views
   
   Knows the pre requisite of pictorial drawings
State three types of pictorial drawings
  Draw isometric view of rectangular blocks, arcs, circles
  Draw oblique sketching of rectangular blocks
  Draw one point perspective view of a rectangular block
  Draw two point perspective view of a rectangular block
  Prepare / draw pictorial drawings of simple objects

9. APPLY GOOD DIMENSIONING ON MULTI-VIEWS AND PICTORIALS
  Define dimensioning
  Identify the types of dimensioning
  Enlist the elements of dimensioning
  Identify the system of measurements
  Indicate complete dimension on multi-view drawings
  Indicate complete dimension or pictorial drawings
  Follow the general rules for dimensioning
  Indicate notes and specification or multi-view drawings

10. APPLY THE SECTIONING METHODS OF MATERIAL AND DRAW SECTIONAL VIEWS
  Define sectioning and its purpose
  Describe cutting planes and lines
  State types of sectional views
  Explain conventional section lines of different materials
  Practice sectioning

11. APPLY DRAWING METHODS TO DRAW MULTI-VIEWS OF MACHINE ELEMENTS
  Draw multi-views of vee-block
  Draw multi-views of gland
  Draw keys and cotters
  Draw multi-views of simple bearing
SECTION – II      COMPUTER AIDED DESIGN

12. UNDERSTAND CAD FUNDAMENTALS

Define CAD
Describe importance of CAD
States purpose of CAD
Explain advantages of CAD
Explain importance of CAD use age in industry

13. UNDERSTAND CAD SOFTWARE

Describe computer system requirements for CAD (e.g. Auto CAD release 12 or latest)
State procedure of giving command to CAD
State CAD (e.g. Auto CAD rel. 12 or latest) abbreviations
State use of function keys
Describe procedure of giving commands with a mouse
Explain procedure of getting general help for a specific command
Explain drawing cursor and co-ordinance read out
Explain Cartesian notion
Explain polar notation

14. UNDERSTAND BORDER TEMPLATE OF DRAWING

Describe setting up of drawing area
Describe setting of displayed digits
Explain changing the drawing limits
Explain use of grid system (Auto CAD rel-12 or latest)
Explain adjustment of drawing scale
Explain procedure of drawing line with line command
Explain p-edit command for widening boarder
Explain procedure of saving boarder template

15. UNDERSTAND ADDING A TITLE BLOCK TO THE BORDER DRAWING

Describe checking the drawing time
Explain change command
Explain creation of layer for title block
Explain procedure of creating a title block
Explain zoom command
Explain importance of saving a drawing
Explain use of CAD (Auto CAD R-12 or latest)
Explain filling in the title block by writing drawing title, name etc.
Explain procedure of plotting drawing on a plotter or printer
Explain Q-save command

16. UNDERSTAND DRAWING LINES AND CIRCLES

State beginning of a new drawing
Explain D-edit command (Auto CAD R-12 or latest)
Describe viewing the entire drawing
Explain drawing of angled line
Explain U-command
Explain Redo command
Explain drawing a circle with circle command
Explain automatic work saving procedures
LIST OF PRACTICAL:

A. (BASIC ENGINEERING DRAWING)

1. Lettering 5mm height
2. Lettering 3mm height
3. Use of tee square and set squares for drawing horizontal, vertical and inclined lines
4. Use of tee square and for drawing centers, crossing of lines
5. Use of compass, circles, half circles, radius
6. Draw round corners, figure inside and outside circle
7. Plane geometry angles and triangles
8. Plane geometry quadrilateral square rhombus, rectangle and parallelogram
9. Plane geometry parallel-lines, perpendicular, bisect line and angle
10. Plane geometry equal division of line and some radio with the help of compass and set square
11. Plane geometry of inscribe and circumscribe square, triangle and hexagon
12. Plane geometry of construction of polygon, five, six, seven and eight sides
13. Plane geometry of inscribe pentagon in a circle and pentagon by general and different methods
14. Plane geometry of tangent of circle inside and outside
15. Plane geometry of construction of ellipse with two methods
16. Plane geometry of construction of ellipse with next two methods
17. Plane geometry of construction of parabola curve 4 methods
18. Plane geometry of construction of hyperbola curve
19. Plane geometry of spiral curve
20. Plane geometry of helix curve
21. Plane geometry of construction of involutes curve of square rectangle hexagon and circle
22. Different types of drawing lines
23. Orthographic projection 1st and 3rd angle L block
24. Orthographic projection 1\textsuperscript{st} and 3\textsuperscript{rd} angle step block
25. Orthographic projection 1\textsuperscript{st} and 3\textsuperscript{rd} angle Vee block
26. Orthographic projection 1\textsuperscript{st} and 3\textsuperscript{rd} angle given block
27. Orthographic projection 1\textsuperscript{st} and 3\textsuperscript{rd} angle additional block
28. Orthographic projection and isometric drawing given block
29. Orthographic projection and isometric drawing given block next
30. Different types of sectioning
31. Different section lines for different material
32. Orthographic projection of vee block sectional views
33. Orthographic projection Gland sectional views
34. Orthographic projection open bearing sectional views
35. Concept for different types of drawings
36. Isometric and oblige drawings of cube with one hole
37. Isometric and oblige drawings of another given block
38. Missing lines and positions on given views
39. Missing lines and positions on given views next
40. Isometric scale and development of cube
41. Development of prism
42. Development of cylinder
43. Development of cone
44. Development of pyramid
45. Thread profile of square and vee threads
46. Different types of threads
47. Sketch of hexagonal nut and bolt
48. Rivet heads
49. Single riveted lap joint
50. Single riveted but joint
B. **COMPUTER AIDED DESIGN (AUTO CAD REL – 12 OR LATEST)**

1. Practice loading CAD software into computer memory
2. Practice unloading CAD software safety and cone to DOS prompt
3. Practice CAD abbreviations, auto CAD release 12 of latest (e.g. A for Arc, C for circle, E for Erase etc.)
4. Practice functions for short cuts
5. Practice to draw two points using Cartesian notation on graph paper
6. Practice to draw straight line using polar coordinates on graph paper
7. Set up drawing area using CAD software
8. Practice for turning GRID ON and OFF and SNAP on and OFF
9. Draw a line with line command
10. Widen border lines with pedit
11. Save border template (Q-Save)
12. Create layers and move border to it’s own layer
13. Create a layer for title block
14. Create title block
15. Practice for zoom command
16. Practice for CAD type face (Auto CAD Rel. 12 or latest)
17. Practice for filling title block
18. Practice for plotting the drawing on plotter or printer
19. Begin a new drawing
20. Practice with Dedit command to make changes in the drawing
21. Draw an angled line
22. Practice with U-command and Redo command
23. Draw a circle with circle command
RECOMMENDED BOOKS:

1. Z.H.Syed “Fundamentals of Construction”
2. Surrender singh “Engineering Materials”
3. N.Chaudary “Building Materials”
5. Kulkarne “Building Construction”
6. Arora and Gupta “Building Construction”
7. Mitchell “Building Construction”
8. Mckay “Building Construction”
10. Alan R.Miller “ABC’s of Auto CAD Release - 12”
SECOND YEAR
GCT 202 WORKSHOP TECHNIQUES

Total Contact Hours 128
Theory 32 1 3 2
Practical 96

COURSE AIM

This course enables the students to have the hands-on experience regarding electrification, welding, lathe Machine and general tools involved in industrial practices. Such practical working will formulate the professionalism in true spirit.

COURSE CONTENTS

1. ELECTRIC WIRING AND CIRCUITS 08 HOURS
   Wires and their gauges
   Circuits and their types
   Different electric circuits

2. LATHE MACHINE AND TOOLS UTILITY 08 HOURS
   Lathe Machine and its parts
   Structure and its functions
   Drilling
   Making holes
   Drill chuck keys
   Operation of lathe machines
   Miscellaneous tools and utilities

3. WELDING WORKS 08 HOURS
   Fuel medium for welding
   Welding apparatus
   Welding operations
   Utility of Welding in ceramics industry

4. GENERAL TOOL KIT AND ITS APPLICATIONS 08 HOURS
   Plain tool kit
   L & N keys
   Utility of tools
INSTRUCTIONAL OBJECTIVES

1. ELECTRIC WIRING AND CIRCUITS
   Explain different wires and their gauges
   Explain different Circuits and their types
   Explain different electric circuits and their formation.

2. LATHE MACHINE AND TOOLS UTILITY
   Describe Lathe Machine and its parts
   Describe the Structure and functions of Lathe Machine.
   Describe the drilling by using Machine.
   Describe the making of holes
   Describe the Drill chuck keys
   Describe the Operation of lathe machines
   Describe the Miscellaneous tools and utilities

3. WELDING WORKS
   Explain Fuel medium for welding
   Explain the welding apparatus
   Explain the welding operations
   Explain the Utility of Welding in ceramics industry

4. GENERAL TOOL KIT AND ITS APPLICATIONS
   Describe the Plain tool kit
   Describe the L & N keys
   Describe the Utility of tools
LIST OF PRACTICAL

1. To make a hole of 3 Cm in a shaft.
2. To make a screw shaft
3. To make a metal die for pressing
4. To demonstrate the lightening of one bulb with one switch.
5. To demonstrate the lightening of one bulb with two switches.
6. To demonstrate the lightening of two bulbs with one switch.
7. To demonstrate the working of a fuse.
8. Joining of two cylinders by welding.
10. Utility of different tool kits in ceramics industry.
GCT 213 GLASS Technology

Total Contact Hours 160
Theory 64
Practical 96

COURSE AIM

The aim of this Course is to give comprehensive knowledge to the students regarding typical raw materials used and their availability in Pakistan. Also it provides information about typical composition of glass and effect of various oxides there on. This course also gives information regarding batch calculations and steps involved during glass preparation.

COURSE CONTENTS

A. 1. Feldspar
   Kinds of feldspar mineral; feldspar as a source of alumina; Melting temperature of feldspar and availability in Pakistan. 3 Hours

2. Glass Sand
   Importance of glass sand, Impurities present in glass sand; forms of Silica. 3 Hours

3. Limestone
   Importance of Limestone, availability in Pakistan. 3 Hours

4. Dolomite
   Availability in Pakistan, Chief Source of Magnisium Oxide MgO. 3 Hours

5. Cryolite
   Use in glass, effect on viscosity

6. Red Lead
   Use in glass

7. Quartz
   Availability in Pakistan, Sandstone 3 Hours

8. Soda Ash
   Importance of soda Ash, Availability in Pakistan.
9. **Potassium Carbonate**
   Main Source of K$_2$O, Manufacture of Potassium Carbonate Impurities in Potassium Carbonates

10. **Potassium Nitrate and Potassium Hydroxide**
    Main Source of K$_2$O, Manufacture of Potassium Carbonate Impurities in Potassium Carbonates

11. **Decolorizer**

12. **Colorants**

13. **Refining Agents**

14. **Cullet**

15. **Phosphate Compounds**

16. **Zirconium**

17. **Calumet**

18. **Barium Compounds, Etc**

B. **Composition of Various Glasses**
   Sheet Glass, Flat Glass, Plate Glass, Float Glass, Neutral Glass

   **Effect of Metallic Oxide**
   Effect of Iron Oxide, effect of titanium oxide, Effect of Chromium Oxide, Effect of Sb$_2$O$_3$, Pb$_2$O$_3$, Effect of cobalt oxide, effect of selenium, etc

   **Batch Calculation**

D. **Preparation of Glass Batch**
   Storage of Raw materials, Removal of impurities, Sand washing, Screw conveyors, Belt Conveyors, Bucket Elevators, Weighing and mixing, Addition of Cullet, Conveying to furnace, variable speed motor
Instructional Objectives

1. Feldspar
   1.1 Explain the kind of Feldspar and the effect of heat, use as flux, oxide obtained from feldspar, use of feldspar in glass composition, availability of feldspar in Pakistan.

2. Glass Sand
   Describe the oxide obtained from the silica sand.
   - Describe the amount which can be used in glass composition
   - Describe the impurities present in glass sand and their effect on glass
   - Explain the sources of glass sand in Pakistan
   - Describe various forms of silica

3. Lime Stone
   Define Lime Stone
   Name the Oxide obtained from Lime stone and its effect on the melting of Glass
   Availability of Lime Stone in Pakistan w.r.t Glass Industry

4. Dolomite
   Describe Dolomite
   Availability of Dolomite Stone in Pakistan w.r.t Glass Industry
   Why Used in glass
   Explain the calcinations and double carbonate.

5. Cryolite
   Describe Cryolite
   Sources of Cryolite
   Discuss availability in Pakistan

6. Red Lead
   Explain the Source of PbO
   Explain the Availability
   Explain the use of Lead Silicate
   Describe the effect of PbO on glass melting and its properties.
7- **Quartz**
   - Describe the properties of Quartz mineral.
   - Availability of Quartz in Pakistan
   - Study the effect of Quartz in glass and the properties of glass

8- **Soda Ash**
   - Differentiate b/w Soda and Soda Ash
   - Sources of Soda
   - Explain effect of melting and the other properties of Glass

9- **Potassium Carbonate**
   - Describe as main source of K2O.
   - Explain the manufacturing of Potassium carbonate
   - Describe impurities present in the salt
   - Explain the effect of Potash on the properties of glass

10- **Potassium nitrate and Hydroxide**
   - Describe as source of Potash
   - Explain the manufacturing of the salts.
   - Describe impurities present in the salt
   - Explain the effect of Potash on the properties of glass

11- **Barium Compound**
   - Describe the Compound
   - Source of BaO
   - Describe preparation of carbonate from sulfate.
   - Use of BaSO4 as BaO
   - Describe effect of BaO on the properties of Glass

12- **Phosphate Compound**
   - ✓ Describe various phosphate compounds

13- **Zirconium Compound**
   - Describe the use of Zirconia in glass
   - Discuss its effect on melting and properties of glass

14- **Calumite**
   - Define Calumite
Describe its use in glass and its effects

15- **Decolorizer**

15.11 Describe the various decolorizer used in glass batch

16- **Refining Agent**

Define Refining Agent

Chemistry of Refining Agent

Various oxide used as refining agents

17- **Cullet**

Describe Cullet

Describe the Factory and Foreign cullet

Describe washing and use in glass batch

**B. Composition of various Glasses**

Define Glass

Describe glass formers, Fluxes and stabilizers

Define Container Glass and various compositions

Define Heat resistant glass and explain its composition

Define Fiber glass and explain its composition

Explain the difference b/w sheet and plate glass

Define Neutral glass and explain its composition

Describe its uses

2. **Effect of Metallic Oxide**

Explain the effect and behavior of iron oxide on composition

Explain the effect and use of Titanium oxide on Glass composition

Explain the effect and use of Chromium oxide on Glass composition

2.4 Explain the effect and use of Refining agent on Glass composition

2.5 Explain the effect and use of Cobalt oxide on Glass composition
3. **Batch Calculations**
   - Explain composition of batch from the given composition
   - Explain calculation of glass composition from given batch
   - Familiarization with different examples

4. **Preparation of Glass Batch**
   - Describe how raw materials are loaded and unloaded
   - Describe drying and washing of Silica sand
   - Describe Crushing and grinding of raw material w.r.t glass industry
   - Beneficiation of Silica sand
   - Describe the construction and working of screw and belt conveyor
   - Explain the construction and working of Bucket Elevators
   - Describe the weighting and mixing of major and minor ingredients
     - Describe how cullet is added
     - Explain the amount of cullet to be added
   - Describe the conveying of mixed batch to glass furnace
   - Explain the working of batch charger and Variable speed motor
GCT- 224  PARTICLE SIZE REDUCTION AND GLAZES

Total Contact Hours  192  T  P  C
Theory  96  3  3  4
Practical  96

COURSE AIM

The objective of this course is to provide absolute knowledge of size reduction and mixing processes and equipment. Simultaneously it will also focus on the types, compositions and effects of various glazes. Lastly, this course will enable the students to diagnose and overcome different glaze defects. It will also give information of various ceramics products.

COURSE CONTENTS

PAPER-A

1. PARTICLES SIZE REDUCTION AND CONTROL / GRADATION OF RAW MATERIAL  16 HOURS

   1.1 Theories
       1.1.1 Impact attrition and collision
       1.1.2 Kick’s, Bond’s and Rittinger’s Laws
       1.1.3 Principles of Fracture
       1.1.4 Comparing efficiencies with other processes (distillation drying etc)
       1.1.5 Particle size analysis

       Taylor Sieves
       ASTM Sieves
       Gravity Sedimentation
       Centrifuge

2. MIXING METHODS  10 HOURS

   Blunger
   Pug mill
   U-Mixer
   Muller Mixer

3. CHANGE DURING FIRING  16 HOURS

   Thermal Decomposition
Clays and other Alumini-slicate oxides, Hydroxides, Carbonates, Other ceramic raw materials
DTA and TGA
Changes in a Ceramic body
   Water smoking
   Dehydration
   Decomposition
   Oxidation
   Reduction

Sintering
   Solid State Sintering
   Sintering in the presence of a liquid phase
   Grain growth
   Vitrification
   Nucleation
   Crystallization

Microstructure
   Development of Microstructure in relation to
   sintering
   Typical Ceramic Microstructure and their control

4. CERAMIC PRODUCTS. 6 HOURS

Ceramic building materials
Ceramics in the home.
Chemical and technical ceramics
Specialized laboratory and engineering ware
Ceramics in the Electrical industry
Insulators.

GLAZES

1- THE NATURE OF GLASS AND GLAZES. 4 HOURS

Silica as the Basis of Glass.
Making of Glass (Brief).
The Distinction between Glass and Glazes.

2- EARLY TYPES OF GLAZES. 6 HOURS

Early lead Glazes.
Ash Glazes.
Slip Glazes.
Feldspathic Glazes.
Salt Glazes.

3- THE OXIDES AND THEIR FUNCTION IN GLAZE FORMING. 8 HOURS

Oxidation and the oxides.
The Glaze oxides.
The function of the oxides in glazes.
How glazes melt in the kiln.
Silica SiO$_2$.
Alumina Al$_2$O$_3$.
Sodium oxide Na$_2$O
Potassium oxide K$_2$O
Lead Oxide PbO
Calcium oxide CaO.
Barium oxide BaO.
Magnesium oxide MgO.
Zinc oxide ZnO.
Strontium oxide SrO.
Antimony oxide Sb$_2$O$_3$
Lithium oxide Li$_2$O
Boric oxide B$_2$O$_3$

4- GLAZE MATERIALS. 6 HOURS

Flint SiO$_2$
Clay Al$_2$O$_3$ 2SiO$_2$ .2H$_2$O
Feldspar
Whiting CaCO$_3$
Magnesium Carbonate MgCO$_3$
Dolomite CaCO$_3$ .MgCO$_3$
Barium Carbonate BaCO$_3$
Talc (3MgO 4SiO$_2$ H$_2$O)
Strontium carbonate SrCO$_3$
Litharge PbO
White lead 2PbCO$_3$Pb(OH)$_2$
Red lead Pb$_3$O$_4$
Zinc Oxide ZnO
Antimony Oxide Sb$_2$O$_3$
Soda Ash or sodium carbonate Na$_2$CO$_3$

5- THE COMPOSITION OF GLAZES. 6 HOURS

Fusion Points of Glazes
Fluxing Action of the various oxides.
The amounts of silica and alumina in glazes.

6- TYPES OF GLAZES. 6 HOURS
   - Low temperature alkaline glazes.
   - Lead glazes.
   - Glazes containing boron.
   - Bristol glazes.
   - Porcelain and stoneware glazes.

7- GLAZE DEFECTS, THEIR CAUSES AND CURES 6 HOURS

8- CERAMIC COLORS & STAINS 6 HOURS
   - Colors in Glazes
   - Red, Pink, Green, Blue and Black Colors
   - Their manufacture & effects on the Glaze and Bodies
   - Over-Glaze colors
   - Under-Glaze colors
   - Manufacturing of stains
   - Uses of stains

RECOMMENDED BOOKS

2. Read, H.H. “Rutley’s Elements of mineralogy” Thomas murley 1948
INSTRUCTIONAL OBJECTIVES

PAPER-A

1. PARTICLES SIZE REDUCTION AND CONTROL / GRADATION OF RAW MATERIAL

1.2 Understand the theories of particles size reduction
   Explain Impact attrition and collision
   Explain Kick’s, Bond’s and Rittinger’s Laws
   Describe Principles of Fracture
   Describe efficiency of size reduction process
   Describe the methods of Particle size analysis of the following sieves:
   Taylor Sieves
   ASTM Sieves
   Gravity Sedimentation
   Centrifuge

2. MIXING METHODS

   Explain the technology of mixing of raw materials by the following machines:
   Blunger
   Pugmill
   U-Mixer
   Muller Mixer

3. UNDERSTAND CHANGE DURING FIRING

   Thermal Decomposition
   Clays and other Alumini-slicate oxides, Hydroxides, Carbonates,
   Other ceramic raw materials
   DTA and TGA
   Changes in a Ceramic body
   3.5.1 Water smoking
   3.5.2 Dehydration
   3.5.3 Decomposition
   3.5.4 Oxidation
   3.5.5 Reduction

3.6 Sintering
   3.6.1 Solid State Sintering
   3.6.2 Sintering in the presence of a liquid phase
   3.6.3 Grain growth
   3.6.4 Vitrification
   3.6.5 Nucleation
3.6.6 Crystallization
Microstructure
Development of Microstructure in relation to sintering
Typical Ceramic Microstructure and their control

4. CERAMIC PRODUCTS.
Describe Ceramic building materials
Explain the Ceramics in the home.
Explain the Chemical and technical ceramics
Explain the role of specialized laboratory and engineering ware
Explain the role of Ceramics in the Electrical industry
Explain the Insulators and their manufacturing

GLAZES

1. THE NATURE OF GLASS AND GLAZES.
Describe the Silica as the Basis of Glass.
Describe the Making of Glass in Brief.
Describe the Distinction between Glass and Glazes.

2. EARLY TYPES OF GLAZES.
Explain Early lead Glazes and their compositions.
Explain Ash Glazes and their compositions.
Explain Slip Glazes and their compositions.
Explain Feldspathic Glazes and their compositions.
Explain Salt Glazes and their compositions.

3. THE OXIDES AND THEIR FUNCTION IN GLAZE FORMING.
Define and explain the Oxidation and the oxides.
Define and explain the Glaze oxides.
Describe the function of the oxides in glazes.
Describe how glazes melt in the kiln.
Describe the effect of Silica SiO₂ on glaze forming.
Describe the effect of Alumina Al₂O₃ on glaze forming.
Describe the effect of Sodium oxide Na₂O on glaze forming.
Describe the effect of Potassium oxide $K_2O$ on glaze forming.
Describe the effect of Lead Oxide $PbO$ on glaze forming.
Describe the effect of Calcium oxide $CaO$ on glaze forming.
Describe the effect of Barium oxide $BaO$ on glaze forming.
Describe the effect of Magnesium oxide $MgO$ on glaze forming.
Describe the effect of Zinc oxide $ZnO$ on glaze forming.
Describe the effect of Strontium oxide $SrO$ on glaze forming.
Describe the effect of Antimony oxide $Sb_2O_3$ on glaze forming.
Describe the effect of Lithium oxide $Li_2O$ on glaze forming.
Describe the effect of Boric oxide $B_2O_3$ on glaze forming.

4. **GLAZE MATERIALS.**

Explain the character of Flint $SiO_2$ as glaze material.
Clay $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$ Explain the character of Flint $SiO_2$ as glaze material.
Feldspar Explain the character of Flint $SiO_2$ as glaze material.
Explain the character of Whiting $CaCO_3$ as glaze material.
Explain the character of Magnesium Carbonate $MgCO_3$ as glaze material.
Explain the character of Dolomite $CaCO_3 \cdot MgCO_3$ as glaze material.
Explain the character of Barium Carbonate $BaCO_3$ as glaze material.
Explain the character of Talc $(3MgO \cdot 4SiO_2 \cdot H_2O)$ as glaze material.
Explain the character of Strontium carbonate $SrCO_3$ as glaze material.
Explain the character of Litharge $PbO$ as glaze material.
Explain the character of White lead $2PbCO_3Pb(OH)_2$ as glaze material.
Explain the character of Red lead $Pb_3O_4$ as glaze material.
Explain the character of Zinc Oxide $ZnO$ as glaze material.
Explain the character of Antimony Oxide $Sb_2O_3$ as glaze material.
Explain the character of Soda Ash or sodium carbonate $Na_2CO_3$ as glaze material.
5. **THE COMPOSITION OF GLAZES.**
   - Define Fusion point and explain Fusion Points of Glazes
   - Define Fluxing action and describe the Fluxing Action of various oxides.
   - Explain the variation in the amounts of silica and alumina in glazes.

6. **TYPES OF GLAZES.**
   - Describe Low temperature alkaline glazes.
   - Describe Lead glazes and their behavior.
   - Describe Glazes containing Boron and their behavior.
   - Describe Bristol glazes and their behavior.
   - Describe Porcelain and stoneware glazes and their behavior.

7. **DESCRIBE DIFFERENT GLAZE DEFECTS, THEIR CAUSES AND CURES**

8. **CERAMIC COLORS & STAINS**
   - Describe the Colors in Glazes
   - Describe the manufacture of Red, Pink, Green, Blue and Black Colors and their effects on the Glaze and Bodies
   - Describe the Over-Glaze colors
   - Describe the Under-Glaze colors
   - Describe the Manufacturing of stains
   - Describe the Uses of stains

9. **CERAMIC PRODUCTS.**
   - Explain the nature and results of Ceramic building materials
   - Explain the Ceramics in the home and its utility in daily life.
   - Explain the Chemical and technical ceramics
   - Explain the Specialized laboratory and engineering ware
   - Explain the Ceramics in the Electrical industry
   - Explain the Insulators and their manufacture.
LIST OF PRACTICALS

1. Study the effect of flow rate on the efficiency of a filter press.
2. Determination of horse power required and the rate of mixing for the mixing different quantities of materials such as salt and sand in dry and wet states.
3. Determination of the number of revolution and time required for homogenous mixing of two materials per unit weight and calculation of the efficiency of the mixer.
4. Determination the horse power required for crushing a definite quantity of a material e.g. red bricks.
5. Determination the horse power required for grinding and definite quantity of a material to hundred mesh in a mill. Also calculate the work index for such a grinding operation.
7. Familiarization with different glaze materials.
8. Familiarization with different body materials.
9. Preparation of different types of glazes.
10. Identification of different glazed defects and their remedies.
GCT 243  PROPERTIES OF GLASS AND CERAMICS MATERIALS

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**COURSE AIMS:**

The students will be able to learn the characteristic properties of Glass and Ceramic Materials and apply this knowledge to comprehend and solve practical problems encountered during production process.

**COURSE CONTENTS**

1. **MECHANICAL PROPERTIES OF MATERIALS**  
   12 HOURS

   Elastic Deformation
   - Stress and strain
   - Tensile and compressive deformations
   - Sheer stress strain
   - Poisson’s Ration

   Elastic Moduli
   - Rotation between cohesive energy and melting point
   - Effect of temperature
   - Anelasticity

   1.3 Plastic Deformation
   - Simple oxides
   - Dislocation in slip
   - Creep
   - Effect of temperature

   Polyphase Materials
   - Mechanism
   - Influence of temperature

   Brittle Fracture
   - Fracture Mechanism
   - Fracture Energy
   - Theoretical Strength of Ionic solids
   - Flaws, their origins and role

   Fracture in single and polyphase materials
   - Strength and strengthening of glass
     - Flaws
     - Influence of flaw size on the strength
     - Methods of strengthening
   - Hardness and Abrasion
     - Relationship with other properties
Elastic modules  
Creep 
Flow strength and phase assemblage  
Abrasions 

2. THERMAL PROPERTIES  

12 HOURS  

Specific Heat  
Data on common ceramic material Effect of temperature  
Latent heat of fusion  
Fusion point  
Melting point 

Thermal Expansion  
Simple ionic crystals: Thermal expansion in relation to potential energy curve, effect of phase transformation  
Glass: Thermal expansion curve and its significance.  
Thermal expansion, composition and structure of Glass  
Polycrystalline materials: Relationship with composition and micro structure  

Thermal Conductivity  
Simple oxides: Relationship with other properties  
Polycrystalline materials: Effect of micro structure porosity and Insulation  
Thermal endurance of glasses w.r.t. composition  

Thermal Stress  
a) Stress in Glass: Permanent and temporary stress, Annealing and tempering  
b) Thermal shock resistance of Glass  
c) Spilling of Ceramics: Effect of Moisture, Effect of shape  
d) Stress at interfaces: Glazes, Enamels and glass to metal seals, micro-stress in relation to micro-structure 

3. OPTICAL PROPERTIES  

12 HOURS  

Reflection and Refection  
RefRACTive index and dispersion: Effect of composition, polarizability, density and temperature  
Reflection in relation to surface texture: Specular reflection and diffused reflection, from glazed surfaces. Reduction of reflection loss  
Scattering and opacity: Opacity in relation to refractive index, particle size, pore size, opal glass and glazes. Transparent and translucent ceramic materials  

Absorption of Radiation  
Ionic colour in vitreous system: Absorption spectrum of transition metal
Ions in U.V., Visible and I.R. regions, oxidation reduction equilibria effect of composition and structure
Colloidal colours: Carbon-sulphur, Amber glass, se-ruby
Fluorescence

Polarization and Birefringence

Crystals: Polariser-Analyser, Tint plate, Mineralogical microscope
Polycrystalline material under a microscope:
Microstructures in transmitted and reflected light
Strain in glass: Strain and polarization of light, measurement of strain in glass, strain discs

Microstructure

Mineralogical Microscope
Preparation of Specimens
Microstructure of typical ceramics materials
Electron Microscope

4. CHEMICAL PROPERTIES 08 HOURS

Surface Chemistry of Vitreous Materials
Attack of water, Alkali and Acids: Reaction process and reaction rates
Effect of composition, weathering of glass surface.
Alkali resistance, ion exchange
Electrode Glasses: Hydrogen and metal ion-electrode
Durability of Glazes and enamels: Effects of composition, effect of
Electrical stress in insulator glaze
Devitrification and phase separation

Chemical Attack on Refractories
Slag’s and glasses
Molten Metals
Glasses
Aqueous Solution

5. ELECTRICAL PROPERTIES 08 HOURS

Conduction
Ionic Conduction: conduction in crystals and polycrystalline ceramics, conduction in glasses, effect of composition and structures
Electronic Condition: Band structure and transport, conduction in crystals and polycrystalline ceramics, semi-conducting glasses.
Dielectric Properties
  Di-electric constant and Di-electric loss: polarization and Di-electric phenomena, effect of temperature and frequency. Di-electric behavior of poly crystalline ceramics. Dielectric behaviors of glasses in relation to composition and structure.
  Dielectric strength
  Insulators
  Ferro-electric phenomena: Ferro-electric behaviors of ceramics in relation to structure.
  Piezo-electric ceramics.
  Electro-optic phenomena in ceramics.

6. MAGNETIC PROPERTIES 06 HOURS

7. PHYSICAL PROPERTIES 06 HOURS
INSTRUCTIONAL OBJECTIVES

1. MECHANICAL PROPERTIES OF MATERIALS

Understand Elastic Deformation
- Define Stress and strain
- Explain Tensile and compressive deformations
- Describe Shear stress strain
- Discuss Poisson’s Ratio

Understand Elastic Moduli
- Develop Rotation between cohesive energy and melting point
- Discuss Effect of temperature
- Explain Anelasticity

1.3 Understand Plastic Deformation
- Explain the role of Simple oxides
- Describe the process of Dislocation in slip
- Discuss Creep
- Illustrate the Effect of temperature

Understand Polyphase Materials
- Describe Mechanism
- Influence of temperature

Understand Brittle Fracture
- Describe Fracture Mechanism
- Describe Fracture Energy

- Explain Theoretical Strength of Ionic solids
- Describe the Flaws, their origins and role

Understand Fracture in single and polyphase materials
Understand Strength and strengthening of glass
- Describe the Flaws
- Describe the Influence of flaw size on the strength
- Explain the Methods of strengthening

Understand Hardness and Abrasion
- Explain the Relationship with other properties
- Describe Elastic modules
- Discuss Creep
- Explain Flow strength and phase assemblage
- Describe Abrasions

2. THERMAL PROPERTIES

Understand Specific Heat
- Explain the effect of common ceramic material
- Effect of temperature
- Define Latent heat of fusion
- Define Fusion point
- Describe Melting point

Understand Thermal Expansion
- Describe the Simple ionic crystals: Thermal expansion in
relation to potential energy curve, effect of phase transformation
Glass: Thermal expansion curve and its significance.
Thermal expansion, composition and structure of Glass
Polycrystalline materials: Relationship with composition and microstructure

Understand Thermal Conductivity
Describe the thermal conductivity in Simple oxides:
Relationship with other properties
Describe the effect of Polycrystalline materials:
Effect of micro structure porosity and Insulation
Explain Thermal endurance of glasses w.r.t. composition

Understand Thermal Stress
a) Describe the formation of Stress in Glass: Permanent and temporary stress, Annealing and tempering
b) Define Thermal shock resistance of Glass
c) Explain Spalling of Ceramics: Effect of Moisture, Effect of shape
d) Describe the Stress at interfaces: Glazes, Anamels and glass to metal seals, micro-stress in relation to micro-structure

3. OPTICAL PROPERTIES

Understand the Reflection and Refraction
Define Refractive index and dispersion: Effect of composition, polarizability, density and temperature
Describe the Reflection in relation to surface texture: Specular reflection and diffused reflection, from glazed surfaces. Reduction of reflection loss
Define Scattering and opacity: Opacity in relation to refractive index, particle size, pore size, opal glass and glazes. Transparent and translucent ceramic materials

Understand Absorption of Radiation
Understand Ionic colour in vitreous system:
Absorption spectrum of transition metal
Describe ions in U.V., Visible and I.R. regions, oxidation reduction equilibria effect of composition and structure
Describe the behavior of Colloidal colors: Carbon-sulphur, Amber glass, se-ruby
Define Fluorescence

Understand Polarization and Birefringence
Define polarization, discuss the Crystals: Polariser-Analyser, Tintplate, Mineralogical microscope
Describe the behavior of Polycrystalline material under a microscope: Microstructures in transmitted and reflected light

Describe the Strain in glass: Strain and polarization of light, measurement of strain in glass, strain discs

Understand Microstructure
Mineralogical Microscope
Preparation of Specimens
Microstructure of typical ceramics materials
Electron Microscope

4. CHEMICAL PROPERTIES
Understand Surface Chemistry of Vitreous Materials
Explain the Attack of water, Alkali and Acids:
Reaction process and reaction rates
Describe the Effect of composition, weathering of glass surface. Alkali resistance, ion exchange
Discuss Electrode Glasses: Hydrogen and metal ion-electrode

Explain the Durability of Glazes and enamels:
Effects of composition, effect of
Explain the Electrical stress in insulator glaze
Define the Devitrification and phase separation

Understand Chemical Attack on Refractories
Describe the effect of Slags and glasses
Describe the effect of Molten Metals
Describe the effect of Glasses
Aqueous Solution

5. ELECTRICAL PROPERTIES
Understand Conduction
Define Ionic Conduction: conduction in crystals and polycrystalline ceramics, conduction in glasses, effect of composition and structures
Describe Electronic Condition: Band structure and transport, conduction in crystals and polycrystalline ceramics, semi-conducting glasses.

Understand Dielectric Properties
Define Di-electric constant and Di-electric loss:
polarization and Di-electric
Explain Phenomena, effect of temperature and frequency.
Di-electric behavior of
Describe the Poly crystalline ceramics. Dielectric behavior of glasses in relation to
Describe the effect of Composition and structure
Describe the Die-electric strength
Describe the factors which effect the die-electric of Insulators
Describe the Ferro-electric phenomena: Fero-electric behavior of ceramics in relation to structure
Explain the Piezoelectric ceramics. Electro-optic phenomena in ceramics.

6. MAGNETIC PROPERTIES
Para magnetism: Paramagnetic properties of crystalline and glass materials containing transition metal ions. Effect of valancy and coordination numbers.
Ferromagnetism: Elementary theory, Hysteresis, Curie point,
Ferromagnetism
Ferromagnetic Ceramics: Spinals, Hexagonal Ferrites, Garnets,
Ferromagnetic behavior in relation to structure, soft ferrites, Hard Ferities, and square loop Hysteresis ferities.

7. PHYSICAL PROPERTIES
Relations of Glass composition to:
Density and Specific Gravity
Viscosity
Surface Tension
Softening point
Annealing point etc.
LIST OF PRACTICALS

1. Dye penetration test
2. Microscopic examination of various types of white wares.
3. Microscopic examination of various types of refractory bricks.
4. Modulus of rupture
5. Compressive strength
6. Abrasion resistance
7. Chipping/impact strength
8. War page.
9. Lead solubility
10. Resistance to slag and glass.
11. Drying rate and grain strength
GCT 263 CERAMIC RAW MATERIALS

Total Contact Hours 160
Theory 64  T  P  C  
Practical 96  2  3  3

COURSE AIM

The students will be able to prepare different ceramics bodies after having comprehensive knowledge of the facts imparted by the various ingredients in raw materials.

Occurrence and availability
Physical and Chemical properties
Clay type 08 HOURS

Origin of Clay
Primary and secondary group Kaolins
Montmorillonite
Little
Plasticity
Drawing and Firing of Clay
Clay Bodies
Testing procedures for evaluation on raw materials for their use in Glass Ceramics industry
Impurities in clays and role there-of

Classification 08 HOURS
China clay Resources in Pakistan
Application in Ceramics
Ball clay Resources in Pakistan
Application in Ceramics
Fireclay Resources in Pakistan
Application in Ceramics
Building clay Resources in Pakistan
Application in Ceramics
Bentonite Resources in Pakistan
Application in Ceramics
Fuller’s earth Resources in Pakistan
Application in Ceramics
2. **Silica Sources**

2.1 Quartz
   2.1.1 Available sources in Pakistan
   2.1.2 Utility in Glass & Ceramics
   2.1.3 Other uses

2.2 Sand
   2.2.1 Available sources in Pakistan
   2.2.2 Utility in Glass & Ceramics
   2.2.3 Other uses

2.3 Sandstone
   2.3.1 Available sources in Pakistan
   2.3.2 Utility in Glass & Ceramics
   2.3.3 Other uses

2.4 Ganister
   2.4.1 Available sources in Pakistan
   2.4.2 Utility in Glass & Ceramics
   2.4.3 Other uses

2.5 Quartzite
   2.5.1 Available sources in Pakistan
   2.5.2 Utility in Glass & Ceramics
   2.5.3 Other uses

   Polymorphic modifications-quartz
   Transformation of quartz into Cristoballite,
   Tridymite
   Action of Heat

   Diatomaceous earth
   Available sources in Pakistan
   Utility in Glass & Ceramics
   Other uses

3. **Silimanite Group**

3.1 Silimanite
   Available sources in Pakistan
   Use as Refractory & Insulator

3.2 Kyanite
   Available sources in Pakistan
   Use as Refractory & Insulator

3.3 Andalusite
   Available sources in Pakistan
   Use as Refractory & Insulator

   Conversion to Mulite

4. **Carbonate Sources**

4.1 Limestone
   Formation & Deposits of Limestone in Pakistan
   Utility in low temperature bodies
   Other uses
4.2 Magnasite
   4.2.1 Formation & Deposits of Magnasite in Pakistan
   4.2.2 Utility in Glass & Ceramics Industry
   4.2.3 Other uses

4.3 Dolomite
   4.3.1 Formation & Deposits of Dolomite in Pakistan
   4.3.2 Utility in Glass & Ceramics Industry
   4.3.3 Other use

4.4 Calcination

5. Fluxes
   04 HOURS
   Feldspar
      Types of feldspar minerals
      Effect of heat
      Application as a flux in Ceramics Bodies
      Use as a flux in Glass Melting
      Orthoclase-plagioclase series
      Felspathoids-Nepheline
      Deposits, quality and uses in Pakistan

6. Miscellaneous
   28 HOURS
   Bauxite
   Diaspore
   Pyrophylite
   Olivine
   Chromite
   Talc
   Bone Ash
   Woolastonite & zircon
   Rutile
   Fluorspar
   Silicon Carbite
   Graphite
   Mica
   Lithium-minerals and beryl

RECOMMENDED BOOKS

1. Read, H.H. “Rutley’s Elements of mineralogy” Thomas murley 1948
INSTRUCTIONAL OBJECTIVES

Occurrence and availability
Physical and Chemical properties
Clay type

Origin of Clay
Primary and secondary group Kaolins
Montmorillonite Clay
Illite clay
Plasticity
Drawing and Firing of Clay
Clay Bodies
Testing procedures for evaluation on raw materials for their use in
Glass Ceramics industry
Impurities in clays and role there-of

Classification Illustrate the occurrences of the following clays in Pakistan and
give an account for their use in glass and ceramic industry

Chinaclay Resources in Pakistan
Application in Ceramics
Ball clay Resources in Pakistan
Application in Ceramics
Fireclay Resources in Pakistan
Application in Ceramics
Building clay Resources in Pakistan
Application in Ceramics
Bentonite Resources in Pakistan
Application in Ceramics
Fuller’s earth Resources in Pakistan
Application in Ceramics

2. Silica Sources Illustrate the occurrences of the following Silica minerals in
Pakistan and give an account for their use in glass and ceramic industry

2.1 Quartz
2.1.1 Available sources in Pakistan
2.1.2 Utility in Glass & Ceramics
2.1.3 Other uses

2.2 Sand
2.2.1 Available sources in Pakistan
2.2.2 Utility in Glass & Ceramics
2.2.3 Other uses
2.3 Sandstone
2.3.1 Available sources in Pakistan
2.3.2 Utility in Glass & Ceramics
2.3.3 Other uses

2.4 Ganister
2.4.1 Available sources in Pakistan
2.4.2 Utility in Glass & Ceramics
2.4.3 Other uses

2.5 Quartzite
2.5.1 Available sources in Pakistan
2.5.2 Utility in Glass & Ceramics
2.5.3 Other uses
Polymorphic modifications-quartz
Transformation of quartz into Cristoballite, Tridymite
Action of Heat
Diatomaceous earth
Available sources in Pakistan
Utility in Glass & Ceramics
Other uses

3. Silimanite Group Illustrate the occurrences of the following Sillimanite group of minerals in Pakistan and give an account for their use in glass and ceramic industry

3.1 Silimanite
3.1.1 Available sources in Pakistan
3.1.2 Use as Refractory & Insulator

3.2 Kyanite
3.2.1 Available sources in Pakistan
3.2.2 Use as Refractory & Insulator

3.3 Andalusite
3.3.1 Available sources in Pakistan
3.3.2 Use as Refractory & Insulator

3.4 Conversion to Mullite

4. Carbonate Sources Illustrate the occurrences of the following carbonate in Pakistan and give an account for their use in glass and ceramic industry

4.1 Limestone
4.1.1 Formation & Deposits of Limestone in Pakistan
4.1.2 Utility in low temperature bodies
4.1.3 Other uses

4.2 Magnasite
4.2.1 Formation & Deposits of Magnasite in Pakistan
4.2.2 Utility in Glass & Ceramics Industry
4.2.3 Other uses

4.3 Dolomite
4.3.1 Formation & Deposits of Dolomite in Pakistan
4.3.2 Utility in Glass & Ceramics Industry
4.3.3 Other use

4.4 Calcination

5. Fluxes

Illustrate the occurrences of the following fluxes in Pakistan and give an account for their use in glass and ceramic industry

5.1 Feldspar

5.1.1 Types of feldspar minerals

5.1.2 Effect of heat

5.1.3 Application as a flux in Ceramics Bodies

5.1.4 Use as a flux in Glass Melting

Orthoclase-plagioclase series

Felspathoids-Nepheline

5.3.1 Deposits, quality and uses in Pakistan

6. Miscellaneous

Bauxite

cibe Bauxite and its sources in Pakistan
cibe Bayer Process and its use as refractory and high Alumina cement

Diaspora

cibe Diaspora and its sources in Pakistan
cibe purification Process and its use as refractory and high Alumina cement

Pyrophyllite

cibe Pyrophyllite and its sources in Pakistan
cuss its composition, and its application in Ceramics Industry

Olivine

cibe Olivine and its sources in Pakistan
cuss its composition, and its application in Ceramics Industry

Chromite

cibe Chromite and its sources in Pakistan
cuss its composition, and and explain the process for making Chromite brick

Talc

cibe Talc and Soapstone and its sources in Pakistan
cuss its composition, and its application in Tile Industry and glazes

Bone Ash

Production of Bone Ash from Kettle Bone
cuss ash grinding and removal of impurities and its substitute

Woolastonite & zircon
describe the minerals and its sources.
cuss their composition, and its application in glass and ceramics industry

Rutile
cube Rutile and its sources in Pakistan
cuss its composition, and its application in Glass & Ceramics Industry

Fluorspar
describe Fluorspar and its sources in Pakistan
discuss its composition, and its application in Glass & Ceramics Industry

Silicon Carbide
describe SiC and its manufacturing techniques
discuss its composition, and its application in Glass & Ceramics Industry

Graphite
describe Graphite and the local available sources
discuss its composition, and its application in Glass & Ceramics Industry

Mica
describe mica and its sources
discuss its composition, and its application in Glass & Ceramics Industry

Lithium-minerals and beryl
describe minerals and its sources and purification
discuss its composition, and its application in Glass & Ceramics Industry
LIST OF PRACTICALS

1. Study the operation of a sieve shaker through the use of variety of crushed solids. (Alternately, a manual sieve screen analysis may be carried out).
2. Study the operation of jaw crusher
4. Silica
   i) Gravimetric method based on dehydration of salicylic acid and residual silica by colorimetric method based on the formation of either yellow or blue silicomolybdate acid.
5. Alumina EDTA titration
   i) Gravimetric method.
6. Sodium oxide
   i) Flame photometric method ii) Gravimetric Zineuranyl acetate method.
7. Potassium oxide
GCT 253 CERAMIC PRODUCTION TECHNIQUES

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**COURSE AIM**

The students will be able to apply the principles of ceramic manufacturing to the commercial production of ceramic products in the industries and develop an organic relationship between the theory and the practice.

**COURSE CONTENTS**

1. **SLIP CASTING**  
   - Properties of aqueous suspensions
   - Normal casting processes
   - Solid casting
   - Pressure casting
   - Deflocculates, their types, behavior, viscosity & thixotropy  
2. **PRESSING**  
   - Simple presses
   - Hydraulic presses
   - Dry pressing
   - Binders in pressing & their properties
   - ISO-static pressing
   - HIP pressing  
3. **THROWING**  
   - Effect of water on bodies for throwing
   - Pugmill & its effects on throwing bodies  
4. **JIGGERING**  
   - 6 HOURS
a. Jiggering
b. Its types

5. **Jolleying** 6 HOURS
   a. Jolleying
   b. Its types

6. **Sintering** 8 HOURS
   a. Various methods of sintering
   b. New techniques of sintering
   c. Sintering of Al₂O₃ & MgO

7. **Drying & Finishing** 10 HOURS
   a. Mechanism of Drying
   b. Bulk drying
   c. Dryers and types
   d. Finishing techniques

8. **Injection Moulding Techniques** 6 HOURS
INSTRUCTIONAL OBJECTIVES

1. SLIP CASTING
   Explain the Properties of aqueous suspensions
   Explain the Normal casting processes
   Define and Explain the Solid casting
   Define and Explain the Pressure casting
   Explain the Deflocculant, its types & behavior, viscosity & thixotropy

2. PRESSING
   Define and Explain the Simple presses
   Define and Explain the Hydraulic presses
   Define and Explain the Dry pressing
   Define and Explain the Binders in pressing & their properties
   Define and Explain the Iso-static pressing
   Define and Explain the HIP pressing

3. THROWING
   Describe the Effect of water on bodies for throwing
   Describe the Pugmill & its effects on throwing bodies

3. JIGGERING
   Define and explain the Jiggering
   Explain the types of jiggering

4. JOLLEYING
   Define and explain the Jolleying
   Explain the types of Jolleying

5. SINTERING
   Describe the Various methods of sintering
   Describe the New techniques of sintering
   Describe the Sintering of Al₂O₃ & MgO

6. DRYING & FINISHING
   Explain the Mechanism of Drying
   Define and Explain the Bulk drying
   Explain the Dryers and types
   Explain the Finishing techniques

7. DEFINE AND DESCRIBE THE INJECTION MOULDING TECHNIQUES

RECOMMENDED BOOKS

2. Introduction to ceramics by WD Kingery John wiley & Sons, New York London
LIST OF PRACTICALS

1. Study the theory and operation of filter press i.e. Filtering, washing cleaning of press by filtering various industrially important slurries.
2. Determinations of flash point and fire point.
3. Determination of Viscosity by Ostwald’s Viscometer.
4. Determination of viscosity by Redwood viscometer.
5. Making and pressing of tiles i.e. Wall Tiles and Floor tiles by various types of Presses e.g. Friction Press, Toggle Press and Hydraulic Press.
6. Fabrication of refractory furniture for the use in Kilns.
Glass, Ceramics & Pottery

THIRD YEAR
لا يمكنني قراءة النص العربي في الصورة. يرجى تقديم النص باللغة العربية مكتوبًا بشكل قراءة طبيعي.
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نام: Glass, Ceramics & Pottery

شماره جلسه: Gen-311

سال 311

کل وقت 20 کیلومتر
مطالعہ پاکستان

صلبیت

تاریخ پاکستان

عوام پاکستان کے کچھ درخواستوں کے بارے میں بھی بحث کی جانے کے لئے

قلمی معاشرے

پاکستان کے کچھ درخواستوں کے بارے میں بھی بحث کی جانے کے لئے

باعثات کے بارے میں بھی بحث کی جانے کے لئے

پاکستان کے کچھ درخواستوں کے بارے میں بھی بحث کی جانے کے لئے

پاکستان کے کچھ درخواستوں کے بارے میں بھی بحث کی جانے کے لئے

پاکستان کے کچھ درخواستوں کے بارے میں بھی بحث کی جانے کے لئے
GCT 302  GLASS MANUFACTURING PROCESSES

Total Contact Hours 128  T P C
Theory 32  1 3 2
Practical 96

**COURSE AIM**

The students would be able to apply the knowledge acquired through Elements of glass in order to prepare different types of industrial glasses while testing various properties thereof.

**COURSE CONTENTS**

1. **GLASS CONDITIONING** 4 HOURS

   The temperature conditions required very greatly according to the articles being manufactured and the process used.

1. **FORMING MACHINES** 4 HOURS

   1. Blow and blow machine
   2. IS Machines
   3. Press and blow machines
   4. Mould and metal forming
   5. Ribbon machine
   6. Classification of machines
   7. Effect related to the speed of production
   8. Time cycle and temperature conditions
   9. Forming defects
   10. Viscosity and working
   11. Bottle shape and design
   12. Bottle weight

3. **TUBE AND RODS MANUFACTURING** 4 HOURS

   Danner process
   Updraw process
   Vello and draw process
   Tube / rod drawing operations

4. **THE PATTERN OF FLAT GLASS DEVELOPMENT** 4 HOURS

   Basic science of flat glass process
   Stress and strain movement in sheet glass
Distortion and lines resulted in the design process
Updraw and downdraw sheet processes
Glass composition in different flat glass

5. **ROLLED GLASS PROCESSES** 3 HOURS
   - Introduction
   - Table cast process
   - The intermittent double roll process
   - The continuous double roll process

5.5. Essential elements of continuous process

6. **WIRED GLASS PROCESS** 4 HOURS
   - Boudin process
   - Drawn cylinder process
   - Wire mesh process

7. **POLISHED PLATE GLASS PROCESS** 4 HOURS

8. **FLAT DRAWN SHEET PROCESS** 4 HOURS
   - Drawn cylinder process
   - Fourcault updraw process
   - Colburn updraw process
   - Slot bushing downdraw process
   - Fusion downdraw process

9. **FLOAT PROCESS** 4 HOURS
   - Introduction
   - Essential features of the process
   - Theory of the float process
   - Float ribbon formation
   - Chemical aspect of the process
   - Modified float process
   - Tinted float glass
   - Supertints float glass
   - Low iron float glass

10. **LAMINATED SAFETY GLASS** 2 HOURS
    - Introduction
    - Manufacturing process
    - Application of the process
    - Cyclone resistant laminated glass
    - Characteristics of anti bandit glass
INSTRUCTIONAL OBJECTIVES

1. GLASS CONDITIONING

Explain where proper temperature conditioning starts in glass melting furnace; Explain effect of article being manufactured on the glass conditioning; Explain the control of refiner temperature; Describe with sketches general layout for owens and flow operation; Explain the working of fore hearth for glass conditioning; Explain the sketch of a bottle; Enlist various steps involved in making a bottle; Explain gathering of glass by Hand, By suction, By gob.

Feeder; Explain the dropping of glass in blank mould; explain the forming of finish by pressure; Explain the forming of parison in blank; Explain removing from blank mould; Explain shaping, buffering and elongation of parison; Explain the transfer to blow mould; Explain cooling in blow mould; Explain subsequent handling, annealing and cooling down.

2. FORMING MACHINES

Blow and blow machines; Explain with sketch the working of blow & blow machine; Explain the working of I.S. machines; Explain the working of press and blow machines; Enlist types of mould; Explain manufacture of moulds; Define “DOPes”; Explain designing of mould; Explain with sketch Westlake paste mould process cycle; Explain the working of ribbon machine; Enlist types of machines; Explain the trends in the speed of machines; Explain the time cycle and temperature
conditions; Classify the forming defects; Explain with sketch machine blown ware faults; Explain were defects and their causes; Explain the relationship of viscosity and working; Describe bottle shape and design parameters; Explain relationship of bottle weight and size.

3. TUBE AND RODS MANUFACTURING
   Explain the Danner process for the manufacture of tube & rod; Describe advantages & disadvantages of danner process; Explain updraw process for production of tube & rod; Explain yellow and downdraw processes; Describe the advantages of vello & down draw process; Explain subsequent drawing operation of the four processes mentioned above.

4. THE PATTERN OF FLAT GLASS DEVELOPMENT
   Explain the basic science of flat glass process; Describe the stress and stretch in an updrawn process as well as in a horizontal ribbon process; Explain lines and distortion in updraw and down draw sheet processes; Explain how the choice of glass composition is a matter of crucial importance; Describe typical glass composition of sheet glass.

5. ROLLED GLASS PROCESSES
   Define the table cast process; Explain use of table east glass; Explain the intermittent double roll process; Describe the use of intermittent double roll glass; Describe the continuous double roll process; Explain various types of continuous double roll process; Describe essential elements of continuous double roll process.

6. WIRED GLASS PROCESS
   Give various types of wired glass processes; Describe boundin & Pilkington double pass wired process; Explain the importance of quality of wire mesh.
7. **POLISHED PLATE GLASS PROCESS**
   Explain the development of polish plate process; Describe the drawn cylinder process;

8. **FLAT DRAWN SHEET PROCESS**
   Describe the equipment and operation of Foucault process; Explain the equipment and operation of the colburn updraw process and glaverbel modification; Explain the elements of slot bushing downward process; Explain the equipment and operation of fusion downdraw process.

9. **FLOAT PROCESS**
   Explain the development of float process; Describe the float bath and equilibrium mode of operation; Explain the theory of float effect and equilibrium thickness; Explain the float ribbon formation; Explain the chemical aspects i.e. properties of tin, oxidation prevention, presence of S&O2 etc; Explain the main features of modified float glass; Explain the use of tinted glass for radiation control; Describe the metal oxides used for tinted glass; Define super tints; Explain the term "spectrally selective"; Explain the use of supertints; Explain the presence of green tinge when viewing from the edge; Describe the amount of iron oxide present in low iron glass.

10. **LAMINATED SAFETY GLASS**
    Defined laminated safety glass; Explain the process of lamination; Explain the benefits of lamination; Describe the applications of laminated safety glass; Define optlight glass and explain the advantages of it; Explain and define cyclone resistant laminate; Explain the composition of an anti bandit glass; Explain edge delamination as a characteristic of laminated glass.

**RECOMMENDED BOOKS**

2. Gunther,R " Glass melting tank furnace" Society of Glass technology
LIST OF PRACTICALS

1. Thermal expansion of Glass.
2. Use of Dilatometer (IS: 5623-1970; ASTM:C-337-57)
3. Under controlled heating rate (CP, LP, Mg and Tg)
4. Littleton softening point (ASTM:C-338-57)
5. Low temperature viscosity by fiber elongation method.
6. Preparation of paperweights.
7. Lenses making.
8. Batch reparation for soda lime glass.
9. Melting and study of soda lime glass.
10. Preparation of batches for various color glasses.
GCT 323  SPECIAL / TECHNICAL CERAMICS

Total Contact Hours  160  T    P   C
Theory               64    2   3   3
Practical            96

COURSE AIM

The objective of this course is to make the students aware of latest techniques and materials that are being brought in to use for numerous practical importances, especially the medical and industrial equipment e.g. Bio – Ceramics, heat exchangers for chemical industry, etc.

COURSE CONTENTS

1.  CERAMIC PARTS FOR VARIOUS INDUSTRIES  12 HOURS
   Chemical Industry – Rashing rings etc.
   Textile Industries – Thread guides etc.
   Paper Industries – Nose &Cones etc.

2.  HIGH TEMPERATURE CERAMICS
    LIKE $\text{Al}_2\text{O}_3$ – MULLITE – ZIRCON BODIES  12 HOURS
    Insulators – Low & High Tension
    Chemical Porcelain and Stoneware
    Thread guides for textile Industry
    Laboratory Porcelain
    Mullite Porcelain
    Alumina bodies for spark plugs

3.  FABRICATION OF VARIOUS PARTS OF SHEATS FOR THERMOCOUPLES  10 HOURS

4.  CHEMICAL PORCELAIN FOR MAKING OF CRUCIBLES, DISHES, GOUCH CRUCIBLES, VARIOUS TYPES OF CERAMIC CAPACITORS, INSULATORS AND RESISTORS, ETC.  10 HOURS
5. CERAMIC HEAT EXCHANGERS FOR CHEMICAL INDUSTRY. 10 HOURS

6. BIO-CERAMICS- INTRODUCTION, MAKING OF ARTIFICIAL TEETH, BONE PARTS, KNEE etc. 10 HOURS
INSTRUCTIONAL OBJECTIVES

1. CERAMIC PARTS FOR VARIOUS INDUSTRIES
   Describe the role of Advanced Ceramics in Chemical Industry – Rashing rings
   Describe the role of Advanced Ceramics in Textile Industries – Thread guides
   Describe the role of Advanced Ceramics in Paper Industries – Nose & Cones

2. HIGH TEMPERATURE CERAMICS LIKE $\text{Al}_2\text{O}_3$ – MULLITE – ZIRCON BODIES
   Explain Insulators – Low & High Tension as high temperature Ceramics
   Explain Chemical Porcelain and Stoneware as high temperature Ceramics
   Explain Thread guide for textile Industry as high temperature Ceramics
   Explain Laboratory Porcelain as high temperature Ceramics
   Explain Mullite Porcelains as high temperature Ceramics
   Explain Alumina bodies for spark plugs as high temperature Ceramics

3. DESCRIBE THE FABRICATION OF VARIOUS PARTS OF SHEETS FOR THERMOCOUPLES

4. DESCRIBE THE CHEMICAL PORCELAIN FOR MAKING OF CRUCIBLES, DISHES, GOUCH CRUCIBLES, VARIOUS TYPES OF CERAMIC CAPACITORS, INSULATORS AND RESISTORS, ETC.

5. DESCRIBE THE CERAMIC HEAT EXCHANGERS FOR CHEMICAL INDUSTRY.

6. DESCRIBE THE BIO-CERAMICS AND INTRODUCE THE MAKING OF ARTIFICIAL TEETH, BONE PARTS KNEE ETC.

RECOMMENDED BOOKS

2) Advances in ceramics, Vol.9 American ceramic society.
3) Advanced Ceramics, Ramakrishna
LIST OF PRACTICALS

1. Preparation of raw Materials up to 99.5 % purity
2. Preparation of bodies by grinding & pulverizing.
3. Pressing of materials / extrusion / Casting, Drying & Finishing of Products and firing above 1250°C according to body compositions.
4. Body composition of Spark plugs and its firing up to 1400°C.
5. Fabrication of thread guides for Textile Industry.
7. Development of Dental Porcelain bodies.
## GCT 353 SANITARY WARES & TILES

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### COURSE AIM

The students will be able to understand various bodies of tile and sanitary wares which is the most profitable ceramic industry of the county.

### COURSE CONTENTS

1. **TILE RAW MATERIALS** 12 HOURS
   - Talc
   - Clay
   - Quartz
   - Feldspar

2. **TILE BODY** 12 HOURS
   - Grinding of Talc
   - Mixing of Clay, Quartz and Feldspar
   - Pulverizing of body composition
   - Granulation of the body materials

3. **MANUFACTURING PROCESSES** 14 HOURS
   - Pressing by toggle, Hydraulic and Screw, etc.
   - Finishing
   - Glazing
   - Firing

4. **SANITARY WARES – RAW MATERIALS** 12 HOURS
   - Clay
   - Quartz
5. FORMING OF SANITARY WARES

Solid casting
Finishing
Glazing
Firing
INSTRUCTIONAL OBJECTIVES

1. TILE RAW MATERIALS
   - Describe Talc as tile raw material
   - Describe Clay as tile raw material
   - Describe Quartz as tile raw material
   - Describe Feldspar as tile raw material

2. TILE BODY
   - Explain the Grinding of Talc
   - Explain the Mixing of Clay, Quartz and Feldspar
   - Explain the Pulverizing of Moisture in body Composition
   - Explain the Granulation of the body materials

3. MANUFACTURING PROCESSES
   - Explains the Pressing by toggle, Hydraulic and Screw, etc.
   - Explain the Finishing
   - Explain the Glazing
   - Explain the Firing

4. SANITARY WARES – RAW MATERIALS
   - Describe Clay as tile raw material
   - Describe Quartz as tile raw material
   - Describe Feldspar as tile raw material

5. FORMING OF SANITARY WARES
   - Explain the Solid casting of sanitary wares
   - Explain the Finishing of sanitary wares
   - Explain the Glazing of sanitary wares
   - Explain the Firing of sanitary wares

RECOMMENDED BOOKS

1. Industrial Ceramics by Singer & Singer.
LIST OF PRACTICALS

1. Preparation of tile body
2. Granulation
3. Pressing of granules
4. Finishing and firing
5. Development of Acid – Proof tiles
6. Making of sanitary ware Moulds of various types.
8. Determination of slip viscosity, thixotropy and specific gravity
9. Casting of slip
10. Drying, finishing and firing
GCT 373  FUELS AND KILNS

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COURSE AIM

Firing of the final product is of supreme importance in the ceramic industry because the main factor of the cost of product is dictated at this stage and most of the problems are diagnosed and encountered at this stage, therefore, this course will enable students about the workability of different fuel sources and the comprehensive insight of Kilns.

COURSE CONTENTS

1. FUELS  10 HOURS
   Types of fuels
   Solid fuels
   Liquid fuels
   Gaseous fuels

2. FURNACES KILNS  10 HOURS

3. REFRACTORY  12 HOURS
   Types of materials,
   Methods to manufacture Uses and properties
   Types of refractories e.g. Acid, Basic & Neutral Refractory
   Physical & Mechanical properties
   P.C.E
   Softening Point
   Load Bearing capacity
   Shrinkage and expansion
   Thermal shock resistance
   Spalling
   Resistance to the action of slugs

4. CERAMIC DRYERS & THEIR TYPES  10 HOURS
Glass, Ceramics & Pottery

5. KILNS 12 HOURS

Kilns and their types
Setting
Firing
Problems and solutions

6. PYROMETER 10 HOURS

Mercury thermometers
Electrical resistances
Thermometers
Thermocouples
Measuring instruments
Radiations & Optical pyrometer
Automatic control of firing pyrometers, cones, their kinds, uses, difficulties & disadvantages in the use of the cones.
INSTRUCTIONAL OBJECTIVES

1. FUELS
   Explain the types of fuels
   Explain the utility of Solid fuels
   Explain the utility of Liquid fuels
   Explain the utility of Gaseous fuels

2 DESCRIBE THE FURNACES & HEATERS

3 REFRACTORY
   Describe the Types of materials,
   Describe the Methods to manufacture
   Describe the Uses and properties of refractories
   Describe the Types of refractories e.g. Acid, Basic & Neutral Refractory
   Describe the Physical & Mechanical properties of refractories
   Describe the P.C.E of refractories
   Describe the Softening Point of refractories
   Describe the Load Bearing capacity of refractories
   Describe the Shrinkage and expansion of refractories
   Describe the Thermal shock resistance of refractories
   Describe the Spalling of refractories
   Describe the Resistance to the action of slugs of refractories

4 EXPLAIN THE DRYERS AND THEIR TYPES

5 KILNS
   Explain the Kilns and their types
   Explain the Setting in kilns
   Explain the Firing in kilns
   Explain the Problems and solutions of kilns

6 PYROMETERY
   Describe the Mercury thermometers
   Describe the Electrical resistances
   Describe the Thermometers
Describe the Thermocouples
Describe the Measuring instruments
Describe the Radiations & Optical pyrometry
Describe the Automatic control of firing pyrometeric cones, their kinds, uses, difficulties & disadvantages in the use of the cones.

RECOMMENDED BOOKS

1) Thrinks, W and Mawhiney, M, “Industrial Furnaces” -“Principles, design and operation” John wiley and sons, New York, 1953
3) Refractories by Norton FH
4) Refractories by Chesters, Sheffield London.

LIST OF PRACTICALS

1. Study of the design of a pottery-baking kiln in a pottery industry.
2. Study of the selection of refractory bricks in different parts of furnace / Kiln.
3. Experiments related to the studies and calculation of furnace kiln and firing practice will be preformed in ceramic industries.
5. To determine the Calorific value of Coal, Coke, Wood, Oil and Natural gas.
6. To draw the sketches of various types of kilns i.e. up – Draft Kiln, Down – draft kiln, Tunnel Kiln and a 50 tone Glass Kiln.
7. To use the Optical Pyrometer.
MGM-311 INDUSTRIAL MANAGEMENT AND HUMAN RELATIONS

Total Contact Hour T P C
Theory 32 1 0 1

AIMS: The study of this subject will enable the student to develop the management skills, 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 Hours
   - History and definition
   - Nature and scope

2. LEADERSHIP 1 Hour
   - Definition and types
   - Definition of a good leader

3. MOTIVATION 2 Hours
   - Definition
   - Types (Financial and non financial motives)
   - Conflict of motives

4. MORALE 1 Hour
   - Importance
   - Development
   - Measurement

5. HUMAN ENGINEERING 1 Hour
   - Importance of human factor in industry
   - Man-machine system
   - Strategy for making allocation decisions

6. INDUSTRIAL FATIGUE AND BOREDOM 2 Hours
   - Definition and distinction
   - Psychological causes
   - Objective causes
   - Prevention

7. INDUSTRIAL ACCIDENTS 2 Hours
   - Psychological causes
   - Objective causes
   - Prevention

8. INDUSTRIAL PREJUDICE 2 Hours
   - Causes
   - Remedies

9. PUBLIC RELATIONS 2 Hours
   - Importance
   - Functions
10. GUIDANCE AND COUNSELLING 2 Hours
   Importance
   Choice of job
   During service

11. JOB EVALUATION 2 Hours
   Importance
   Methods
   Job satisfaction
   Work simplification

12. INDUSTRIAL MANAGEMENT 2 Hours
   Introduction
   Functions of management.
   Subdivisions of management
   Objectives of industrial management

13. PERSONNEL SELECTION 2 Hours
   Recruitment of employees
   Training
   Effects of training on production and product cost

14. WORKING CONDITIONS 2 Hours
   Importance and consideration
   Effects on efficiency and per unit cost

15. TIME AND MOTION STUDY 3 Hours
   Concept and importance
   Sequence of motion study
   Principles of motion study
   Steps to time study
   Determination of operations time

16. QUALITY CONTROL 2 Hours
   Concept and advantages
   Methods.

17. ROLE OF FOREMAN IN MANAGEMENT 2 Hours
   Foreman's abilities
   Duties and functions

BOOKS RECOMMENDED:
MGM-311  INDUSTRIAL MANAGEMENT AND HUMAN RELATIONS.

INSTRUCTIONAL OBJECTIVES

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

1. KNOW INDUSTRIAL PSYCHOLOGY
   - Describe brief history of industrial psychology
   - Describe in detail definition of industrial psychology
   - State nature and scope of industrial psychology

2. KNOW LEADERSHIP
   - Define leadership
   - Describe types of leadership
   - State qualities of a good leader

3. UNDERSTAND MOTIVATION
   - Define motivation
   - Describe financial and non-financial motives
   - Explain conflict of motives

4. KNOW MORALE
   - State importance of morale
   - Describe development of morale
   - State the method of measurement of morale

5. UNDERSTAND HUMAN ENGINEERING
   - Explain importance of human engineering in the industry
   - Explain man-machine system
   - Explain strategy for making allocation decisions

6. UNDERSTAND INDUSTRIAL FATIGUE AND BOREDOM
   - Define fatigue and boredom
   - Describe psychological causes of fatigue and boredom
   - Describe objective causes of fatigue and boredom
   - Explain measures to prevent fatigue and boredom

7. UNDERSTAND INDUSTRIAL ACCIDENTS
   - Explain psychological causes of industrial accidents
   - Explain objective causes of industrial accidents
   - Explain measures to prevent industrial accidents

8. UNDERSTAND INDUSTRIAL PREJUDICE
   - Define prejudice
   - Explain causes of industrial prejudice
   - Explain remedies of industrial prejudice

9. UNDERSTAND THE SIGNIFICANCE OF PUBLIC RELATIONS
   - Explain importance of public relations
   - Explain functions of public relations

10. UNDERSTAND THE NEED FOR GUIDANCE AND COUNSELLING
    - State importance of guidance and counseling
    - Explain the role of guidance and counseling in choosing the job
    - Describe help of guidance and counseling during service
11. **UNDERSTAND JOB EVALUATION**
   - Explain importance of job evaluation.
   - Explain methods of job evaluation.
   - Explain job satisfaction.
   - Explain work simplification.

12. **UNDERSTAND INDUSTRIAL MANAGEMENT**
   - Define management.
   - State functions of management.
   - Enlist subdivision of management.
   - Explain objectives of industrial management.

13. **UNDERSTAND TRAINING AND ITS EFFECTS**
   - Describe the recruitment procedure of employees in an industrial concern.
   - Explain training.
   - Identify the kinds of training.
   - Explain the effects of training on production and product cost.

14. **UNDERSTAND THE EFFECT OF WORKING CONDITION ON EFFICIENCY**
   - Explain importance of working condition.
   - Describe air-conditioning, ventilation, lighting and noise.
   - State the effects of good working conditions on efficiency and per unit cost.

15. **UNDERSTAND TIME AND MOTION STUDY**
   - Explain the concept.
   - Describe the importance of work-study.
   - Explain the sequence of motion study.
   - State the principles of motion study.
   - Describe the steps for carrying out time study.
   - Explain the method of determination of operations time.

16. **UNDERSTAND THE METHOD OF QUALITY CONTROL**
   - Define quality control.
   - State the advantages of quality control.
   - Explain methods of quality control.

17. **UNDERSTAND THE ROLE OF FOREMAN IN AN INDUSTRIAL UNDERTAKING**
   - Explain ability of the foreman.
   - Enlist duties of foreman.
   - Describe functions of foreman as middle management.
OHSE 301 OCCUPATIONAL HEALTH, SAFETY AND ENVIRONMENT

Total contact hours

| Theory: 32 Hours | T | P | C |

Pre-requisite: None

AIMS: After completing the course the students will be able to understand the costs associated with occupational injuries and ways to develop positive attitudes towards occupational health and safety issues.

COURSE CONTENTS

1. PROMOTING HEALTH AND SAFETY
   4 Hours
   The Occupational Health and Safety (OH&S) program.
   The essential components of a health and safety policy
   The basic concepts to risk management.

2. MECHANICAL HAZARDS
   2 Hours
   Mechanical Hazards of power-driven tools and Machines
   Types of Injuries.
   Requirements and types of machine safeguards.
   Lockout/tagout system.

3. FALLING, IMPACT, ACCELERATION, AND LIFTING HAZARDS
   2 Hours
   Causes of falls and categories.
   Elements of slip and fall prevention programmes.
   Recommended procedures for ladder safety.
   Impact and acceleration hazards.
   Lifting hazards and their relation to back injuries.
   Materials handling, both manual and mechanical.

4. ELECTRICAL HAZARDS
   2 Hours
   Sources of electrical hazards.
   Effects of electricity on humans.
   Methods of reducing electrical hazards.
   Steps to be taken to assist a victim of electric shock.

5. FIRE HAZARDS
   2 Hours
   Sources of fire hazards.
   Methods of reducing fire hazards.
   Emergency procedures and means of escape.
   Classification of fire extinguisher.

6. CHEMICAL HAZARDS
   4 Hours
   Occupational diseases and illnesses.
   Agents which can cause disease and illness.
   Three routes of entry of chemicals into the body.
   Classification of effects of substances.
7. PHYSICAL HAZARDS
   4 Hours
   Noise.
   Vibration.
   Heat Stress.
   Radiation.
   Lasers
   7.5 Lighting

8. CONFINED SPACES HAZARDS
   2 Hours
   Characteristics of a confined space.
   Hazards involved in confined spaces.
   Safety measures to be taken while working in confined spaces.

9. PERSONAL PROTECTIVE EQUIPMENT
   4 Hours
   Head protectors.
   Types of protection for the feet.
   Protection for hands and arms.
   Protection of the eyes and face in various applications.
   Types of hearing protection.
   Respiratory protection.

10. ACCIDENT PREVENTION
    4 Hours
    Stages of an accident investigation and analysis.
    The importance of good house-keeping in a workplace.
    The essential sections of a Material “Safety Data Sheet.
    Safe handling and storage of chemicals.

11. FIRST AID
    2 Hours
    ABCs of First Aid.
    First Aid training program.
    Contents of a typical First Aid kit.
    MSDS

REFERENCE BOOKS
3. The occupational Environment-Its Evaluation and control, Editor Dinardi (AIHA Press).
INSTRUCTIONAL OBJECTIVES

1. **PROMOTING HEALTH AND SAFETY**
   - Outline the reasons for an Occupational Health and Safety (OH&S) program.
   - Illustrate the essential components of a health and safety policy.
   - Realize the benefits of rules and regulations on OH&S.

2. **MECHANICAL HAZARDS**
   - Identify mechanical hazards of power-driven tools and machines.
   - Describe types of injuries that can be caused by these tools and machines.
   - Requirements and types of machine safeguards.
   - Explain what a lockout/tagout system is.

3. **FALLING, IMPACT ACCELERATION, AND LIFTING HAZARDS**
   - List causes of falls and categorize them.
   - Outline key elements of slip and fall prevention programs.
   - Discuss recommended procedures for ladder safety.
   - Describe impact and acceleration hazards.
   - Identify lifting hazards and their relation to back injuries.
   - 3.6 Discuss materials handling, both manual and mechanical.

4. **ELECTRICAL HAZARDS**
   - Describe sources of electrical hazards.
   - Describe the effects of electricity on humans.
   - Describe some methods of reducing electrical hazards.
   - Outline steps to be taken to assist a victim of electric shock.

5. **FIRE HAZARDS**
   - Describe sources of fire hazards.
   - Describe methods of reducing fire hazards.
   - Describe emergency procedures and means of escape.
   - Describe the fire extinguisher classifications.

6. **CHEMICAL HAZARDS**
   - Describe occupational diseases and illnesses.
   - Define, with some of their properties, agents which can cause disease and illness.
   - Explain the three routes of entry of chemicals into the body.
   - Describe classification of effects of substances.

7. **PHYSICAL HAZARDS**
   - Describe typical methods of controlling exposure to noise.
   - Explain typical methods of control of vibrations.
   - Describe the effects of radiation on humans and outline exposure control.
   - Describe typical effects of lasers on humans and outline exposure control.
   - Explain common problems of lighting and their effects.
   - Describe illnesses that can be caused by heat stress and discuss its control.

8. **CONFINED SPACES HAZARDS**
   - Discuss the characteristics of a confined space.
   - Explain the hazards involved in confined spaces.
   - Describe safety measures to be taken while working in confined spaces.
9. **PERSONAL PROTECTIVE EQUIPMENT**
   - Describe head protectors.
   - Describe various types of protection for the feet.
   - Describe protection for hands and arms.
   - Describe protection of the eyes and face in various applications.
   - Describe different types of hearing protection.
   - Outline safe handling and storage of chemicals.

10. **ACCIDENT PREVENTION**
    - Outline stages of an accident investigation and analysis.
    - Explain the importance of good house-keeping in a workplace.
    - Outline the essential sections of a Material Safety Data Sheet.
    - Discuss safe handling and storage of chemicals.

11. **FIRST AID**
    - State the ABCs of First Aid.
    - List the essential activities of a basic First Aid training program.
    - List the contents of a typical First Aid kit.
    - Recognize an MSDS as a source of information about First Aid.
GCT-363-Project

Note: The project will be awarded at the start of academic year.