



BANGLADESH TECHNICAL EDUCATION BOARD

Agargaon, Dhaka-1207.

4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM
SYLLABUS (PROBIDHAN-2016)

REFRIGERATION AND AIR CONDITIONING TECHNOLOGY

TECHNOLOGY CODE: 672

FIRST SEMESTER

**DIPLOMA IN ENGINEERING
PROBIDHAN-2016**

Refrigeration and Air-conditioning Technology

1st Semester

Sl. No	Subject Code	Name of the subject	T	P	C	Marks				Total
						Theory		Practical		
						Cont. assess	Final exam	Cont. assess	Final exam	
1	61011	Engineering Drawing	0	6	2	0	0	50	50	100
2	65711	Bangla	3	3	4	60	90	50	0	200
3	65712	English	2	0	2	40	60	0	0	100
4	65911	Mathematics-I	3	3	4	60	90	50	0	200
5	65912	Physics-I	3	3	4	60	90	25	25	200
6	67011	Basic Workshop Practice	0	6	2	0	0	50	50	100
7	67211	Refrigeration and Air Conditioning Fundamentals	2	3	3	40	60	25	25	150
		Total	13	24	21	260	390	250	150	1050

ENGINEERING DRAWING (61011)

T P C
0 6 2

OBJECTIVES:

- To develop the ability to use various drawing instruments and materials.
- To enable in constructing and using various types of scales in drawing.
- To provide the ability to construct various geometrical figures.
- To enable to adopt various symbols used in drawing.
- To understand the orthographic and isometric projection.

SHORT DESCRIPTION:

Drawing instruments and their uses; Lettering, numbering and constructing title strip; Adopting alphabet of lines and dimensioning; Constructing scales; Constructing geometrical figures; Constructing conic sections; Adopting symbols; Views and isometric projections.

DETAIL DESCRIPTION:

1 Practice with drawing instruments and materials for basic drawing technique.

- 1.1 Identify the different types of drawing instruments.
- 1.2 Use different types of drafting equipment.
- 1.3 Identify different types of drafting software.
- 1.4 Identify the standard sizes of drawing board and sheets.
- 1.5 Draw the border lines in drawing sheets following standard rule.
- 1.6 Draw horizontal, vertical and inclined lines with the help of set squares and T-square.
- 1.7 Draw 15 degree, 75 degree, 105 degree and 120 degree angles with the help of set squares.
- 1.8 Use lettering guide, template, scale pantograph and French curve.

2 Practice Letter and number freehand and with instruments.

- 2.1 Identify the necessity of good lettering in engineering drawing.
- 2.2 Draw freehand single stroke vertical letters from A to Z (upper and lower case) and numbers 0 to 9.
- 2.3 Draw freehand inclined (65 degree to 75 degree) single stroke letters from A to Z (upper and lower case) and numbers from 0 to 9.
- 2.4 Draw block letters (Gothic) using 5: 4 proportions.
- 2.5 Select a suitable size of letters and write a few sentences using all the letters selecting suitable scale.
- 2.6 Draw title strip with proper placement using suitable size of letters and measurements.

3 Adopt the alphabet of lines.

- 3.1 Select different lines in drawing.
- 3.2 Use center line, hidden line, phantom line, break line, dimension line, extension line, section line and cutting plane line.
- 3.3 Use different thickness of line to emphasize a part of drawing.
- 3.4 Select recommended grades of pencils for various types of lines for engineering drawing.

4 Adopt the elements and theory of dimensioning.

- 4.1 Put dimensions in engineering drawing according to an accepted standard.
- 4.2 Identify the elements of dimensions from a given dimensioned drawing.
- 4.3 Apply aligned and unidirectional system of dimensioning.
- 4.4 Draw size and location of dimension, continuous dimension, staggered dimension and dimensioning in limited space.
- 4.5 Add necessary dimension to a given drawing with suitable arrows.

5 Prepare scale for drawing application.

- 5.1 Calculate representative fraction and interpret a scale reading.
- 5.2 Use different types of scale to find full size dimension.
- 5.3 Draw a plain scale to show meter, centimeter and millimeter of a given distance on object.
- 5.4 Draw a diagonal scale to show three units having given RF.
- 5.5 Read particular distance on plain and diagonal scale.
- 5.6 Use scale of chord.
- 5.7 Draw angle of 49 degree, 78 degree and 95 degree with the help of scale of chord.

6 Construct geometric figures (regular polygons) & Construct conic sections.

- 6.1 Draw regular polygons i.e. pentagon, hexagon and octagon having given one side.
- 6.2 Draw an ellipse by concentric circle method.
- 6.3 Draw an ellipse by parallelogram method.
- 6.4 Draw an ellipse by four center method.
- 6.5 Draw a parabola having given foci and director.
- 6.6 Draw a parabola from given abscissa and ordinate.

7 Adopt standard symbols in drawing.

- 7.1 Identify symbols used in drawing.
- 7.2 Draw a legend using symbols of different engineering materials.
- 7.3 Draw the symbols of different plumbing fittings and fixtures used in drawing.
- 7.4 Draw the symbols of different electrical fittings and fixtures used in drawing.
- 7.5 Interpret information from drawing containing standard symbols.

8. Understand the views of engineering drawing.

- 8.1 Identify different types of views
- 8.2 Interpret different types of views

9 Apply the Principles of orthographic projection to a straight line.

- 9.1 Draw the orthographic projection of a straight line under the following conditions : -
 - a) Line parallel to both planes
 - b) Line perpendicular in vertical plane and parallel to horizontal plan
 - c) Line parallel to vertical plane and perpendicular to horizontal plane
 - d) Line inclined at given angle to horizontal plane and parallel to vertical plane
 - e) Line inclined at given angle to vertical plane and parallel to horizontal plane

10 Apply the principles of orthographic projection of rectangular and circular planes (Lamina)

- 10.1 Draw the orthographic projection of rectangular lamina Parallel to both planes.
- 10.2 Draw the orthographic projection of rectangular lamina inclined at given angle to horizontal plane
- 10.3 Draw the orthographic projection of circular lamina parallel to both planes

11 Apply the principles of orthographic projections of geometric solids

- 11.1 Draw the orthographic projection of a cube kept at an angle with one of the planes in first angle method
- 11.2 Draw the orthographic projection of a pyramid kept at an angle with both the planes in 1st angle method
- 11.3 Draw the orthographic projection of a cone kept at an angle with both the planes in third angle method.
- 11.4 Draw the orthographic projection of a prism kept at an angle with vertical plane in third angle method.

12 Understand the importance, use and scope of isometric views in engineering.

- 12.1 Identify isometric views
- 12.2 Draw the isometric view of rectangular and circular lamina
- 12.3 Draw the isometric projection of solids such as: cube, cylinder, pyramid, prism and steps from different orthographic views
- 12.4 Draw the isometric projection of three deterrent engineering parts from orthographic views

REFERENCE BOOKS:

- 1 Geometrical Drawing - I H Morris
- 2 Prathomic Engineering Drawing - Hemanta Kumar Bhattacharia
- 3 Civil Engineering Drawing - Guru Charan singh

BANGLA (65711)

T	P	C
3	3	4

উদ্দেশ্য :

১. মাতৃভাষা হিসেবে বাংলা ভাষার প্রকৃতি ও বৈশিষ্ট্য সম্পর্কে ধারণা লাভ। ভাষার ব্যবহারে প্রায়োগিক যোগ্যতা অর্জন।
২. বাংলা সাহিত্য পঠন-পাঠনের মাধ্যমে জাতীয় চেতনা, দেশপ্রেম, মুক্তিযুদ্ধের চেতনা, শুদ্ধাচার, নীতি ও মূল্যবোধের উন্মেষ ঘটানো।

সংক্ষিপ্ত বিবরণী :

মাতৃভাষা ও সৃজনশীলতা : বাংলা ভাষা রীতির বিচিত্রতা, বানান রীতি, পত্র রচনা এবং কবিতা, প্রবন্ধ, নাটক, উপন্যাস ও ছোট গল্প।

বিশদ বিবরণী:

১। বাংলা ভাষার প্রয়োগ:

ভাষার সংজ্ঞা, বাংলা ভাষা রীতি - সাধু, চলিত, আঞ্চলিক বা উপভাষা (সংজ্ঞা, বৈশিষ্ট্য, পার্থক্য ও উদাহরণ)

২। বাংলা বানান রীতি ও শব্দ প্রয়োগ:

- ২.১। বাংলা একডেমির প্রমিত বানান রীতি, গ-ত্ব ও ষ-ত্ব বিধি
- ২.২। শব্দ ও শব্দের শ্রেণি বিভাগ (সংজ্ঞা, শব্দের গঠন, উৎস বা উৎপত্তি ও অর্থগত)
- ২.৩। বাক্য প্রকরণ ও গঠন রীতি (সংজ্ঞা, বাক্য গঠন এবং প্রকার)

৩। পত্র রচনা অনুশীলন:

- ৩.১। আবেদন পত্র (চাকুরি, ছুটি),
- ৩.২। চাকুরিতে যোগদান পত্র,
- ৩.৩। মানপত্র,
- ৩.৪। স্মারকলিপি,
- ৩.৫। সংবাদপত্রে প্রকাশের জন্য পত্র

৪। কবিতা চর্চা:

- ৪.১। বঙ্গভাষা -মাইকেল মধুসূদন দত্ত
- ৪.২। সোনার তরী - রবীন্দ্র নাথ ঠাকুর
- ৪.৩। উমর ফারুক -কাজী নজরুল ইসলাম
- ৪.৪। বাংলার মুখ আমি- জীবনানন্দ দাশ
- ৪.৫। আসাদের শার্ট - শামসুর রাহমান
- ৪.৬। স্বাধীনতা শব্দটি কি করে আমাদের হলো? - নির্মলেন্দু গুণ

৫। প্রবন্ধ জানা :

- ৫.১। অর্ধাসী -রোকেয়া সাখাওয়াত হোসেন
- ৫.২। বইকেনা - সৈয়দ মুজতবা আলী

৬। একাঙ্কিকা (নাটিকা):

- ৬.১। মানুষ -মুনীর চৌধুরী

৭। উপন্যাস:

- ৭.১। লালসালু - সৈয়দ ওয়ালী উল্লাহ

৮। ছোট গল্প:

- ৮.১। হৈমন্তী - রবীন্দ্র নাথ ঠাকুর
- ৮.২। একুশের গল্প - জহির রায়হান
- ৮.৩। পাতালেহাসপাতালে - হাসান আজিজুল হক

ব্যবহারিক:

১। নির্ধারিত বক্তৃতা অনুশীলন:

বাংলাদেশ ও বাঙালি সংস্কৃতি, বিভিন্ন জাতীয় দিবস (একুশে ফেব্রুয়ারি ও আন্তর্জাতিক মাতৃভাষা দিবস, স্বাধীনতা দিবস, বিজয় দিবস, জাতীয় শোক দিবস, মুজিব নগর দিবস, মহান মে দিবস)

প্রাতিষ্ঠানিক বক্তৃতা- নবাগত শিক্ষক/ছাত্রছাত্রীদের বরণ, গুরুত্বপূর্ণ ব্যক্তিবর্গের আগমন উপলক্ষে বক্তৃতা।

২. উপস্থিত বক্তৃতায় অংশগ্রহণ: বিষয়বস্তু উন্মুক্ত

৩. আবৃত্তি অনুশীলন : ১. মানুষ

- কাজী নজরুল ইসলাম

২. আকাশ নীলা

- জীবনানন্দ দাশ

৩. পল্লী জননী

- জসীম উদ্দীন

৪. ছাড়পত্র

- সুকান্ত ভট্টাচার্য

৫. তোমাকে পাওয়ার জন্য হে স্বাধীনতা - শামসুর রাহমান

৬. নিষিদ্ধ সম্পাদকীয় - হেলাল হাফিজ

৪. বিতর্ক প্রতিযোগিতা (নমুনা)

সংস্কৃতিই আধুনিক মানুষের ধর্ম

তথ্য প্রযুক্তির অবাধ ব্যবহারই যুব সমাজের অবক্ষয়ের মূল কারণ

গতানুগতিক শিক্ষা নয় কর্মমুখি শিক্ষাই অর্থনৈতিক মুক্তির চাবিকাঠি

চালকের অসাবধানতাই সড়ক দুর্ঘটনার প্রধান কারণ

মুক্তিযুদ্ধের চেতনাই অসাম্প্রদায়িক বাংলাদেশ প্রতিষ্ঠার মূলমন্ত্র

প্রযুক্তির বিকাশই প্রকৃতি বিনাশের একমাত্র কারণ

৫. প্রতিবেদন প্রণয়ন ও উপস্থাপন:

স্থানীয় বিভিন্ন সমস্যা ও অনুসন্ধানী যে কোন বিষয়।

ENGLISH (65712)

T P C
2 0 2

OBJECTIVES:

After the completion of the course, learners will be able to develop-

- Reading & listening skills with understanding
- The fluency of speech
- Grammatical accuracy with emphasis on spelling, punctuation and pronunciation
- Creative writing for communication in real life situation
- Integrating reading, listening, writing & speaking skills

DETAIL DESCRIPTION:

Reading Skill:

1. Demonstrate the ability to use reading skill.

- 1.1 Read the mentioned text and take notes covering the main points, facts from passage read.
- 1.2 Recognize how ideas relate to communicative competence.
- 1.3 Use digital dictionaries to discover pronunciation, spelling, meaning and uses.
- 1.4 Identify main points and summarize the text.

Contexts and Situations- (Seen comprehension : Marks-20)

Unit	Lesson	Title
People Or Institutions Making History (Unit one)	1	Nelson Mandela, from Apartheid Fighter To President
	2	The Unforgettable History
Food Adulteration (Unit Three)	1	Food Adulteration Reaches Height
	2	Eating Habits and Hazards
Human Relationship (Unit Four)	2	Love and Friendship
Environment and Nature (Unit Eight)	1	Water,Water Everywhere
	5	Kuakata: Daughter Of The Sea
Greatest Scientific Achievement (Unit Thirteen)	1	Some Of The Greatest Scientific Achievements Of The Last 50 Years
	2	Science and Technology Against an Age- old Disease
Art and Music (Unit Fourteen)	1	What is Beauty?
	3	Crafts In Our Time
Tours and Travels (Unit Fifteen)	1	Travelling to A village in Bangladesh
	4	The Wonders of Vilayet

N.B: The Unit mentioned refers to the Text Book (1st Paper) English for Today for class 11 – 12 By National Curriculum & Text Book Board, Dhaka.

Listening Skill:

2. Demonstrate the ability to use listening skill.

- 2.1 Listen to instructions and follow them.
- 2.2 Take notes from a short talk, story or explanation.
- 2.3 use e-book or reading software to follow the accent and pronunciation of the native speaker.

Speaking Skill:

3. Demonstrate the ability to use speaking skill.

- 3.1 Ask and answer questions about objects/events/processes.
- 3.2 Ask and answer questions about what they have read, listened and written.
- 3.3 Participate in controlled conversations in various social situations.

Writing Skill:

4. Demonstrate the control of writing skill.

- 4.1 Develop paragraphs from points/outlines
- 4.2 Write guided paragraph about people, places, events and day -to-day life.
- 4.3 Write guided letter and applications.
- 4.4 Describe objects , events, status and process.

Functions:

1. Writing dialogues with teacher, principal, shopkeeper, hotel manager, station master, newcomer, buyers, doctor, friend, colleagues.
2. Writing reports on different events/occasions/accidents.
3. Writing situational personal and official letters
4. Writing job applications with CV/appointment letter/joining letter
5. Writing guided paragraphs with clues

Grammar: Marks-20 (Context & Situations)

(Grammatical items, structures and vocabulary relevant to notions and contexts given bellow will be followed)

1. (a) Uses of Articles.

(b) Uses of Tense (Right forms of verbs with indicators)

(c) Classify verbs (Regular and Irregular verbs, Auxiliary, Principal, finite, non-finite verbs,)

2. Sentence:

(a) Changing Sentences: (Assertive, Interrogative, Optative, Imperative, Exclamatory Simple, Complex and Compound), Comparison of Adjectives/Adverbs

(b) Question making: WH, Yes/No, Tag question

3. Enrich vocabulary: synonyms, Antonyms; suffix and prefix.

4. Voice, Narration

5. Sentence Analysis:

- a. Study of part of Speech (Type of verbs-Regular and Irregular verbs, Auxiliary and Principal verb)
- b. Study of Phrases and Clauses (noun/adjective/verb/participle/adverbial/prepositional phrases and principal/sub ordinate /co ordinate clauses)

MATHEMATICS-1 (65911)

T	P	C
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OBJECTIVES:

- To acquaint the students with the basic terminology of Algebra.
- To be able to understand the complex numbers which are being used in electrical engineering.
- To be able to understand the binomial expansion.
- To be able to use the knowledge of trigonometry in solving problems of engineering importance.

SHORT DESCRIPTION:

Algebra: AP & GP, polynomials & polynomial equations, complex number, permutation & combination, binomial theorem for positive integral index and negative & fractional index.

Trigonometry: ratio of associated angles, compound angles, transformation formulae, multiple angles and sub-multiple angles.

DETAIL DESCRIPTION:**1 Understand the concept of AP & GP.**

- 1.1 Define AP and common difference.
- 1.2 Find last term and sum of n terms, given first term and common difference.
- 1.3 Define GP and common ratio.
- 1.4 Find the sum of n terms given first and common ratio.

2 Apply the concept of polynomial in solving the problems.

- 2.1 Define polynomials and polynomial equation.
- 2.2 Explain the roots and co-efficient of polynomial equations.
- 2.3 Find the relation between roots and co-efficient of the polynomial equations.
- 2.4 Determine the roots and their nature of quadratic polynomial equations.
- 2.5 Form the equation when the roots of the quadratic polynomial equations are given.
- 2.6 Find the condition of the common roots of quadratic polynomial equations.
- 2.7 Solve the problems related to the above.

3 Understand the concept of complex numbers.

- 3.1 Define complex numbers.
- 3.2 Perform algebraic operation (addition, subtraction, multiplication, division, square root) with complex number of the form $a + ib$.
- 3.3 Find the cube roots of unity.
- 3.4 Apply the properties of cube root of unity in solving problems.

4 Apply the concept of permutation.

- 4.1 Explain permutation.
- 4.2 Find the number of permutation of n things taken r at a time when,
 - i) Things are all different.
 - ii) Things are not all different.
- 4.3 Solve problems related to permutation:
 - i) Be arranged so that the vowels may never be separated.
 - ii) From 10 men and 6 women a committee of 7 is to be formed. In how many ways can this be done so as to include at least two women in the committee.

5 Apply the concept of Combination.

- 5.1 Explain combination.
- 5.2 Find the number of combination of n different things taken r at a time.
- 5.3 Explain nCr , nCn , $nC0$
- 5.4 Find the number of combination of n things taken r at a time in which p particular things
 - i) Always occur
 - ii) never occur.

- 5.5 Establish i) $nCr = nCn-r$
 ii) $nCr + nCr-1 = n+1Cr$
 5.6 Solve problems related to the combination.

6 Apply partial fractions to break the numerator and denominator.

- 6.1 Define proper and improper fractions.
 6.2 Resolve into partial fraction of the following types:
 a) Denominator having a non-repeated linear factor.
 b) Denominator having a repeated linear factor.
 c) Denominator having a quadratic factor.
 d) Denominator having a combination of repeated, non repeated and quadratic factors.

7 Apply the concept of the binomial theorem.

- 7.1 State binomial expression.
 7.2 Express the binomial theorem for positive index.
 7.3 Find the general term, middle term, equidistant term and term independent of x.
 7.4 Use binomial theorem to find the value of
 i) $(0.9998)^2$, correct to six places of decimal.
 ii) $(1 + \sqrt{2})^5 - (1 - \sqrt{2})^5$

8 Apply the concept of the binomial theorem for negative index.

- 8.1 Express the binomial theorem for negative and fractional index.
 8.2 Solve problems of the following types:

Expand (i) $(1 - nx)^{-\frac{1}{n}}$ (ii) $\frac{1}{\sqrt{4.08}}$

9 Apply the concept of associated angles.

- 9.1 Define associated angles.
 9.2 Find the sign of trigonometrical function in different quadrants.
 9.3 Calculate trigonometrical ratios of associated angle.
 9.4 Solve the problems using above.

10 Apply the principle of trigonometrical ratios of compound angles.

- 10.1 Define compound angles.
 10.2 Establish the following relation geometrically for acute angles.
 i) $\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$.
 ii) $\cos(A \pm B) = \cos A \cos B \pm \sin A \sin B$.
 10.3 Deduce formula for $\tan(A \pm B)$, $\cot(A \pm B)$.
 10.4 Apply the identities to work out the problems:
 i) Find the value of $\sin 75^\circ$, $\tan 75^\circ$.
 ii) Show that $\frac{\sin 75^\circ + \sin 15^\circ}{\sin 75^\circ - \sin 15^\circ} = \sqrt{3}$
 iii) if $\alpha + \beta = \theta$, $\tan \alpha + \tan \beta = b$, $\cot \alpha + \cot \beta = a$,
 Show that $(a - b) = ab \cot \theta$.

11 Apply sum and product formula of trigonometrical ratios.

- 11.1 Express sum or difference of two sines and cosines as a product and vice-versa
 11.2 Solve problems of the Following types:
 i) Show that, $\sin 55^\circ + \cos 55^\circ = \sqrt{2} \cos 10^\circ$
 ii) Prove that, $\cos 80^\circ \cos 60^\circ \cos 40^\circ \cos 20^\circ = \frac{1}{16}$

12 Apply the concept of ratios of multiple angles.

- 12.1 State the identities for $\sin 2A$, $\cos 2A$ and $\tan 2A$.
 12.2 Deduce formula for $\sin 3A$, $\cos 3A$ and $\tan 3A$.
 12.3 Solve the problems of the following types.
 i) express $\cos 5\theta$ in terms of $\cos \theta$.

ii) if $\tan \alpha = 2 \tan \beta$, show that, $\tan (\alpha + \beta) = \frac{3 \sin 2\alpha}{1 + 3 \cos 2\alpha}$

13 Apply the concept of ratios of sub-multiple angles.

13.1 Find mathematically the identities for $\sin \alpha$, $\cos \alpha$ and $\tan \alpha$ in terms of $\frac{\alpha}{2}$ and $\frac{\alpha}{3}$

13.2 Solve the problems of the type:

find the value of $\cos 3^\circ$, $\cos 6^\circ$, $\cos 9^\circ$, $\cos 18^\circ$, $\cos 36^\circ$ etc.

REFERENCE:

SL No	Author	Title	Publication
01	S. P Deshpande	Mathematics for Polytechnic Students	Pune Vidyarthi Graha Prakashan
02	H. K. Das	Mathematics for Polytechnic Students (Volume I)	S.Chand Prakashan
03	Ashim Kumar Saha	Higher Mathematics	Akshar Patra Prakashani
04	S.U Ahamed & M A Jabbar	Higher Mathematics	Alpha Prakashani

PHYSICS-I (65912)

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3	3	4

OBJECTIVES:

- To develop the students a background of basic science, i.e. Physics required for understanding technological subjects.
- To develop a working knowledge of common engineering and industrial materials and to enable to determine through experiments the properties of such materials.
- To develop through experiments an understanding of fundamental scientific concept.
- To develop a basic knowledge and the concept of physical properties of common engineering and industrial materials.

SHORT DESCRIPTION:

Measurement, Units; Vector and Scalar quantities; Motion and Equations of motion; Force and Newton's Laws of motion; Gravity and Gravitation; Simple Harmonic motion; Hydrostatics; Surface tension and viscosity; Pressure, Sound; wave and sound Concepts and nature of sound, Velocity of sound, Ultrasonic.

DETAIL DESCRIPTION:

Theory:

1. Understand Physical World and Measurement.

- 1.1. Nature of Physical World.
- 1.2. Scope and Excitement of Physics.
- 1.3. Few Terms about Physics.
- 1.4. Physics and other world of Technological Knowledge.
- 1.5. Principle of Measurement.
- 1.6. Fundamental and Derived Quantities and Units.
- 1.7. Dimensions of Units.
- 1.8. Errors in Measurement.

2. Understand scalar and vector quantities.

- 2.1. Define vector and scalar quantities with examples.
- 2.2. Show the various representations of the vector quantities; and representation of a vector by unit vector.
- 2.3. Find and explain the resultant of two vectors in different directions.
- 2.4. Resolve a vector into horizontal & vertical component.
- 2.5. Explain the dot and cross product of two vectors.
- 2.6. Define laws of triangle of vector.

3. Understand Motion and equations of motion

- 3.1. Define rest and motion
- 3.2. Classify and explain of motion.
- 3.3. Define and explain displacement, speed, velocity, acceleration and retardation.
- 3.4. Deduce the relationship between displacement, velocity, acceleration and retardation from these definitions.
- 3.5. Show motion of a projectile.
- 3.6. Equation of motion of a freely moving body thrown obliquely vertically upward or motion of a projectile.
- 3.7. Define angular velocity and linear velocity with their units.
- 3.8. Deduce the relation between angular velocity and linear velocity.
- 3.9. Define centripetal and centrifugal force with examples.
- 3.10 Prove that centrifugal force = $\frac{mv^2}{r}$
- 3.11 State and explain the laws of falling bodies and mention the equation of motion of a body when it is projected vertically upwards or downwards.

4. Understand Newton's laws of motion, force and friction.

- 4.1. Define force.
- 4.2. State Newton's laws of motion.

- 4.3. Define different units of force and their correlation and also mention the dimension of force.
- 4.4. Prove $P=mf$, from Newton's 2nd law of motion.
- 4.5. Find out the resultant of parallel forces.
- 4.6. Define inertia and momentum
- 4.7. State and prove the principles of conservation of momentum.
- 4.8. Define friction and describe the different kinds of friction.
- 4.9. Define the co-efficient of static friction.
- 4.10. Show that the co-efficient of static friction is equal to the tangent of the angle of repose
- 4.11. State the merits and demerits of friction.

5. Understand Gravity and gravitation.

- 5.1. Define and explain the Kepler's Law.
- 5.2. Define gravity and gravitation.
- 5.3. Define and determine the gravitational constant (G) and also mention its units and dimension.
- 5.4. Define acceleration due to gravity 'g' and also mention its units and dimension.
- 5.5. Discuss the variation of 'g' at different places.
- 5.6. Define mass and weight with their units and dimension.
- 5.7. Distinguish between mass and weight.
- 5.8. Define and explain gravitational potential and escape velocity

6. Understand Simple Harmonic Motion (SHM)

- 6.1. Define Periodic and simple harmonic motion (SHM).
- 6.2. State the characteristics of SHM.
- 6.3. Describe a simple pendulum and a second pendulum.
- 6.4. Define effective length, amplitude, phase, complete oscillation, period of oscillation, frequency.
- 6.5. State and explain the laws of simple pendulum.
- 6.6. Explain the motion of a simple pendulum and determine its time period.

7. Understand Work, Power and Energy.

- 7.1. Define work, power and energy.
- 7.2. State the units and dimensions of work, power and energy.
- 7.3. State and prove the principle of the conservation of energy.
- 7.4. Define potential energy (PE) and kinetic energy (KE).
- 7.5. Derive the equation of potential and kinetic energy.
- 7.6. Recognize that the useful work can be found from:

$$\text{Efficiency} = \frac{\text{output work}}{\text{input work}} \times 100.$$

8. Understand Elasticity.

- 8.1. Name some of the general and special properties of matter.
- 8.2. Define Elasticity and Elastic limit.
- 8.3. Define perfectly elastic body and perfectly rigid body.
- 8.4. Define stress and strain with their units and dimensions.
- 8.5. State and explain the Hook's law.
- 8.6. Describe various kinds of modulus of elasticity.
- 8.7. Mention the units and dimensions of modulus of elasticity.
- 8.8. Define and explain Poisson's ratio.

9. Understand Hydrostatics.

- 9.1. Define pressure as force per unit area and state that it is measured in N/m² or Pascal.
- 9.2. State characteristics of liquid pressure.
- 9.3. Establish the pressure at a point in a fluid depend upon the density of the fluid, the depth in the fluid and acceleration due to gravity.
- 9.4. State surface tension and surface energy, Angle of contact.
- 9.5. Define capillarity and theory of capillarity.
- 9.6. Explain viscosity and co-efficient of viscosity.
- 9.7. Mention the necessity of viscosity.

10. Understand Wave and sound.

- 10.1. Define wave and wave motion.
- 10.2. Differentiate transverse wave and longitudinal wave.
- 10.3. Define some terms relating waves.
- 10.4. Compare progressive wave and stationary waves.
- 10.5. Mention equation of progressive wave.
- 10.6. Define sound and production of sound.
- 10.7. Explain sound is a longitudinal traveling wave.
- 10.8. Interference of sound: Constructive and Destructive interference.
- 10.9. Define beats and Mechanism of formation of beats.

11. Understand Sound and velocity of sound.

- 11.1. Identify that sound is produced by vibration and travels through a medium as a longitudinal wave.
- 11.2. Recognize that sound can be produced of different pitches (frequencies) & that the human ear has an audible frequency range covering approximately 20 Hz to 20 KHz.
- 11.3. State the approximate frequency range for
- 11.4. Define Infrasonic sound and Ultrasonic (supersonic) sound.
- 11.5. Explain how sound is absorbed, reflected & refracted by different types of surface.
- 11.6. Describe the practical uses of echo sounding devices.
- 11.7. Define velocity of sound.
- 11.8. State the velocity of sound at NTP in still air.
- 11.9. Compare the effects of pressure, temperature & humidity on the velocity of sound in air.

PRACTICAL:

1. Determine accurate diameter/side of an object using vernier calipers.
2. Measure the area of cross section of a wire by micrometer screw gage.
3. Measure the thickness of a glass plate by speedometer.
4. Verify the law of the parallelogram of forces by a force board.
5. Draw $L-T^2$ graph and determine the value of "g" by using a simple pendulum.
6. Determine the coefficient of static friction.
7. Determine Young's modulus of a steel wire by Searle's apparatus.
8. Determine gravity of a solid heavier than and insoluble in water by hydrostatic balance.
9. Determine specific gravity of a liquid by specific gravity bottle.
10. Determine velocity of sound by resonance air column method.

REFERENCE BOOKS:

1. Higher Secondary Physics - First Part - Dr. Shahjahan Tapan
2. A Text Book of Properties of matter - N Subrahmanyam and Brij Lal
3. A Text Book of Sound - N Subrahmanyam and Brij Lal
4. Higher Secondary Physics- First Part - Prof. Golam Hossain Pramanik
5. Higher Secondary Physics- First Part - Ishak Nurfungnabi

BASIC WORKSHOP PRACTICE (67011)

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AIMS:

To provide the students with an opportunity to acquire knowledge and skills to

- Perform different metal & fitting works.
- Perform basic welding works.
- Use and take care of fitting and welding tools & equipment.

SHORT DESCRIPTION:

Fitting : Safety Precautions, Common hand tools; Measuring instruments; Laying out; Sawing, chipping, filing, grinding and finishing, drilling and thread cutting;

Welding: Arc welding; Gas welding; welding with non-ferrous metal; Resistance welding;TIG & MIG welding;Gas & Plasma cutting.

Practical:

1 Understand the safely productions in Fitting & welding shop:

- 1.1. State general safety precaution in Fitting shop.
- 1.2. State general safety precaution in welding shop.
- 1.3. State the importance of good house keeping.

2 Demonstrate the application of basic metal working hand tools.

- 2.1 Identify common hand tools used for metal and fitting works.
- 2.2 Check hand tools for sharpness.
- 2.3 Carryout minor maintenance and sharpening of tools used for fitting works.
- 2.4 Follow safety procedure during working in the fitting shop.

3 Demonstrate the application of measuring instruments and gages for bench work.

- 3.1 Identify the measuring and layout tools.
- 3.2 Take measurement with vernier caliper and micrometer.
- 3.3 Measure and layout a fitting job.
- 3.4 Check/measure with gages (sheet and wire gage, drill gage, etc).

4 Show skill in sawing, chipping, filing, drilling, reaming and grinding.

- 4.1 Identify the operations of sawing, chipping, filing, drilling, reaming and.
- 4.2 Perform sawing, chipping, filing, drilling, reaming and grinding operations.
- 4.3 Make a job involving sawing, chipping, filing, drilling, reaming and grinding operations (Hinge, Angle gage, etc).
- 4.4 Follow safety procedures during sawing, chipping, filing, drilling, reaming and grinding.

5 Show skill in cutting threads.

- 5.1 Identify the taps and dies.
- 5.2 Cut internal and external threads with tap and die.
- 5.3 Follow safety procedures during working with taps and dies.

6 Show skill in making sheet metal jobs.

- 6.1 Select appropriate sheet metal.
- 6.2 Select tools and equipment for sheet metal works.
- 6.3 Layout the sheet for jobs.(Development Drawing)
- 6.4 Make seam joint.
- 6.5 Rectangular tray, Dust pan, Funnel etc.

7 Show skill in Arc Welding:

- 7.1 Identify the Arc welding machine.
- 7.2 Select tools and equipment for Arc welding.
- 7.3 Prepare a workpiece for an Arc welding joint.
- 7.4 Select Proper current and voltage for Arc welding.
- 7.5 Select appropriate electrode.
- 7.6 Practice uniform and straight weld bead.
- 7.7 Make Arc welding joints 1F, 2F (Lap, butt, tee, corner, etc.)
- 7.8 Follow safe working procedures during Arc welding.

8 Show skill in Gas Welding:

- 8.1 Identify the Gas welding cylinders.
- 8.2 Select tools and equipment for Gas welding.
- 8.3 Prepare a workpiece for a Gas welding joint.
- 8.4 Select appropriate a filler rod and flux.
- 8.5 Select appropriate flame for Gas welding.
- 8.6 Practice uniform and straight weld bead.
- 8.7 Make Gas welding joints 1F, 2F (Lap, butt, tee, corner, etc.)
- 8.8 Follow safe working procedures during Gas welding.

9 Show skill in Gas and Plasma cutting

- 9.1 Identify the Gas cutting torch and Plasma cutting machine.
- 9.2 Select tools and equipment for Gas cutting and Plasma cutting machine.
- 9.3 Select appropriate flame and high pressure oxygen flow for gas cutting.
- 9.4 Select appropriate current, voltage and high presser air flow for plasma cutting.
- 9.5 Metal cutting by gas and plasma cutting machine.
- 9.6 Follow safe working procedures during Gas and plasma cutting machine.

10 Show Skill in TIG Welding:

- 10.1 Identify the TIG welding machine.
- 10.2 Select tools and equipment for TIG welding.
- 10.3 Prepare a workpiece for a TIG joint.
- 10.4 Select Proper current and voltage for TIG welding.
- 10.5 Select appropriate electrode and holder / electrode casing.
- 10.6 Practice uniform and straight weld bead.
- 10.7 Make TIG welding joints 1F (butt.)
- 10.8 Follow safe working procedures during TIG welding.

11 Show Skill in MIG Welding:

- 11.1 Identify the MIG welding machine.
- 11.2 Select tools and equipment for MIG welding.
- 11.3 Prepare a workpiece for a MIG joint.
- 11.4 Select Proper current and voltage for MIG welding.
- 11.5 Select appropriate electrode and pressure roller.
- 11.6 Practice uniform and straight weld bead
- 11.7 Make MIG welding joints 1F (butt.)
- 11.8 Follow safe working procedures during MIG welding.

12 Show skill in resistance welding.

- 12.1 Identify the resistance welding machines.
- 12.2 Identify accessories and tools for resistance welding.
- 12.3 Make spot welding joints.
- 12.4 Follow safe working procedures during working with spot welding machine.

REFERENCE BOOKS:

- 1 Basic Sheet Metal Practice — J. W. Giachino
- 2 Prathomic Fitting Sikkha — Hemanta Kumar Bhattacharia
- 3 Welding Principles for Engineers — Morris
- 4 Metal Fabrication — Robert L. O'con
- 5 Sheet Metal Work — Blackburn & Cassidy
- 6 Manufacturing Technology Lab Manual — T Jeyapoovan • S Sundaram

REFRIGERATION & AIR-CONDITIONING FUNDAMENTALS (67211) T P C 2 3 3

Objectives

To provide the students with an opportunity to acquire fundamental knowledge and basic skills of refrigeration and air-conditioning with special emphasis on:

- Working procedure of refrigeration system.
- Working procedure of air-conditioning system.
- Selecting and handling common tools, equipment and materials for refrigeration and air-conditioning works.

Short Description

History and Principle of refrigeration and air-conditioning; Thermodynamics applied to refrigeration and air-conditioning; Refrigeration and air-conditioning system; Refrigeration and air-conditioning tools, equipment and materials; Refrigerants and refrigerant oil; Psychrometry; Development of refrigeration and air-conditioning.

Detail Description

Theory:

- 1 Understand history and principle of refrigeration and air-conditioning.**
 - 1.1 Discuss the history of refrigeration and air-conditioning.
 - 1.2 State the principle of refrigeration.
 - 1.3 State the principle of air-conditioning.

- 2 Understand the basic concepts of thermodynamics applied to refrigeration and air-conditioning.**
 - 2.1 Explain the terms and the principles of thermodynamics applied to refrigeration and air-conditioning: (temperature, pressure, heat and heat flow, specific heat, sensible heat, latent heat, total heat, evaporation, enthalpy, entropy.)
 - 2.2 Mention the properties of saturated liquid, dry saturated vapor, superheated vapor and sub cooled liquid.
 - 2.3 Explain the basic idea of the first and second laws of thermodynamics.
 - 2.4 State the properties and laws of perfect gas.
 - 2.5 Calculate the total heat/ enthalpy required from below freezing temperature of ice to superheated vapor.

- 3 Understand the basic concept of refrigeration systems.**
 - 3.1 Explain the conventional and unconventional refrigeration systems.
 - 3.2 Describe the vapor compression refrigeration system .
 - 3.3 Draw vapor compression refrigeration cycle in P-H Chart.
 - 3.4 Describe the vapor absorption refrigeration system.
 - 3.3 Define TR, COP, EER.

- 4 Understand the basic air-conditioning systems**
 - 4.1 State the meaning of air-conditioning
 - 4.2 Explain the importance of air-conditioning in different fields.
 - 4.3 Describe briefly the common types of air conditioner

- 5 Understand the application of refrigerants and refrigerant oil in refrigeration and air conditioning system.**
 - 5.1 Define refrigerants
 - 5.2 Mention the properties of ideal refrigerants
 - 5.3 Explain CFC, HCFC, HFC, HC, HC blends, azeotropic and zeotropic refrigerants
 - 5.4 Mention the Properties of R-22, R-290, R-410A, R-600a,.

- 5.5 Mention the alternative refrigerants used in refrigeration and air-conditioning appliances in the present situation.
- 5.6 Define refrigerant recovery, recycling, Retrofit and reclaim, .
- 5.7 State the purpose of compressor lubricating oil.
- 5.8 Mention the Properties of compressor lubricating oil.
- 5.9 Classify the compressor lubricating oil.

6 Understand the concept of Psychometry.

- 6.1 State the meaning of psychometry
- 6.2 Mention the properties of air by psychometric chart.
- 6.3 Mention the properties of air by volume and weight.
- 6.4 State the meaning of humidification and dehumidification.
- 6.5 Explain the meaning of psychometric terms: dry air, moist air, and saturated air, degree of saturation, humidity, absolute humidity, relative humidity, dry bulb temperature, wet bulb temperature, dew point temperature, and enthalpy.

7 Understand the development of refrigeration and air-conditioning.

- 7.1 State the development of refrigeration and air-conditioning.
- 7.2 State the recent application of refrigeration (Mini cold storage, display case, Inverter type refrigerator etc.)
- 7.3 State the recent application of air-conditioner (VRF air-conditioner, HVAC, Inverter type split air-conditioner, Precession air-conditioner etc.)

Practical:

- 1 Identify the tools used in refrigeration and air conditioning works.
- 2 Identify the equipment used in refrigeration and air conditioning field.
- 3 Identify the Cooling and heating appliances used in refrigeration and air conditioning field.
- 4 Identify the materials used in refrigeration and air conditioning works. (Copper, steel & aluminum tube; brazing & filler rod; gasket; compressor oil, cleaning agent; tie clip & wires / cables; soldering lead, flux; emery cloth, emery paper, water paper; epoxy resin; paint, thinner, polish; insulating materials; rowel bolt, rowel plug; screws & nut-bolts; hinges; insulating taps; refrigerants .)
- 5 Observe the operation of a window & split type air-conditioner.
- 6 Observe the operation of vapor compression refrigeration system
 - a. Identify the Main Components/Equipment's.
 - b. Measure the low side and high side pressure.
 - c. Measure the low side and high side Temperature.
- 7 Perform the tube cutting, bending and swaging of copper tube.**
 - 7.1 Select proper copper tube & tools.
 - 7.2 Perform Copper tube cutting.
 - 7.3 Practice tube bending in different angle.
- 8 Perform Copper tube cutting, bending and swaging of copper tube.**
 - 8.1 Select proper copper tube & tools.
 - 8.2 Practice tube cutting.
 - 13.3 Practice tube swaging.
 - 13.4 Practice tube Flaring.
- 9 Perform the brazing of copper tube**
 - a. Select proper tools & materials for brazing work.
 - b. Perform brazing in correct method.

10. Evacuation & Refrigerant Charging in a Refrigerator.
11. Identify the different refrigerants used in the vapor compression system.
12. Identify the different lines of psychometric chart.
13. Determine dew point temperature, specific humidity, relative humidity, enthalpy, specific volume of comfort air conditioned space and outside air.
12. Copper Tube joining By lokring assembly tools.

Reference Books

- | | | |
|---|---|-------------------------------|
| 1 | Fundamentals of Refrigeration | -Billy C. Langley |
| 2 | Modern Refrigeration and Air-conditioning | -Althouse/Turnquist/Bracciano |
| 3 | Basic Refrigeration and Air-conditioning | -P N Ananthanarayanan |
| 4 | A Text Book of Refrigeration and Air-conditioning | -R. S. Khurmi, J. K. Gupta |
| 5 | Principle of Refrigeration | -Roy J. Dossat |
| 6 | Industrial refrigeration Handbook | - Wilbirt F stoecker |
| 7 | A course in refrigeration and air conditioning | - Arora Domkundwar |
| 8 | Refrigeration and Air conditioning | - Md. Solayman |