HEATING, VENTILATION, AIR CONDITIONING & REFRIGERATION (HVAC&R) TECHNOLOGY

SCHEME OF STUDIES

1st Year

Sr.#	CODE		SUBJECT	T	P	C	Page
1.	GEN	111	Islamiat & Pak Studies	1	0	1	
2.	ENG	112	English	2	0	2	
3.	MATH	113	Applied Math - I	3	0	3	
4.	PHY	122	Applied Physics	1	3	2	
5.	CH	112	Applied Chemistry	1	3	2	
6.	MT	111	Technical Drawing	0	3	1	
7.	ET	113	Applied Electricity	2	3	3	
8.	COMP	142	Computer Applications	1	3	2	
9.	HVAC	113	Principles of Refrigeration	2	3	3	
10.	HVAC	121	Safety in HVAC&R Systems	1	0	1	
11.	HVAC	132	Workshop Practice-I	0	6	2	
			a) Metal Shop 0 3 1				
			b) Machine Shop/Welding Shop 0 3 1				
			Total	**14**	**24**	**22**	

2nd Year

Sr.#	CODE		SUBJECT	T	P	C	Page
1.	GEN	211	Islamiat & Pakistan Studies	1	0	1	
2.	MATH	223	Applied Math-II	3	0	3	
3.	MGM	242	Business Management & Accounting	2	0	2	
4.	PHY	212	Applied Physics / Applied Mechanics	1	3	2	
5.	HVAC	214	Principle of Air Conditioning	3	3	4	
6.	HVAC	223	Applied Thermodynamics in HVAC&R Systems	2	3	3	
7.	HVAC	233	Engg. Architectural and Computer Aided Drawing	1	6	3	
8.	HVAC	243	Advance Refrigeration	3	0	3	
9.	HVAC	253	HVAC&R Workshop Practice-II	1	6	3	
			Total	**17**	**21**	**24**	

3rd Year

Sr.#	CODE		SUBJECT	T	P	C	Page
1.	GEN	311	Islamiat & Pakistan Studies	1	0	1	
2.	MGM	321	Business Communication	1	0	1	
3.	MGM	322	Industrial Management & Human Resource Development	2	0	2	
4.	ELR	311	Basic Electronics Applied to HVAC&R Systems	0	3	1	
5.	HVAC	315	Air conditioning System Design	4	3	5	
6.	HVAC	322	Water & Air Distribution	2	0	2	
7.	HVAC	334	Controls & instrumentation	3	3	4	
8.	HVAC	342	Industrial Refrigeration & Air-conditioning Machines & Equipment	2	0	2	
9.	HVAC	353	Heat Transfer and Refrigeration Calculations	3	0	3	
10.	HVAC	363	Workshop Practice – III	0	9	3	
			Total	**18**	**18**	**24**	
			GRAND TOTAL: 49		**63**	**70**	

SUMMARY

	Related courses		
Year	T	P	C
1st	11	15	16
2nd	07	03	08
3rd	04	00	04
Total	22	18	28

Ref. & Air Cond. Tech.		
T	P	C
04	09	07
10	18	16
13	24	21
27	51	44

Total		
T	P	C
15	24	23
17	21	24
17	24	25
49	69	72

Ratio of Theory & Practical in %
(In terms of Hours)

Year	Theory % age	Practical % age	Total % age
1st	38.5	61.5	100
2nd	44.7	55.3	100
3rd	41.5	58.5	100
Total	124.7	175.3	-
% age	41.5	58.5	100

اسلامیات/مطالعہ پاکستان

		ٹی	پی	سی
حصہ اول اسلامیات	GEN III			
حصہ دوم مطالعہ پاکستان		1	0	1
موضوعات حصہ اول اسلامیات	سال اول	کل وقت: 20 گھنٹے		

کتاب و سنت

(ا) قرآن مجید

-1 تعارف قرآن مجید 2- نزول قرآن 3- مکی و مدنی سورتوں کی خصوصیات 4- وحی کی اقسام 5- پندرہ منتخب آیات مع ترجمہ

1.1 تنالوا البر حتی تنفقوا مما تحبون

1.2 واعتصموا بحبل اللّٰہ جمیعا" ولا تفرقو

1.3 ولا یجرمنکم شنان قوم علی ان لا تعدلوا

1.4 ان اللّٰہ یامرکم ان تودوا الامانات الی اھلھا

1.5 ان اللّٰہ یامر بالعدل والاحسان

1.6 ان الصلوتہ تنھی عن الفحشاء وامنکر

1.7 لقد کان لکم فی رسول اللّٰہ سوۃ حسنتہ

1.8 ان اکرمکم عند اللّٰہ اتقاکم

1.9 وما آتاکم الرسول فخرزووما نھی عنھوانتھوا

1.10 ولوفو بالعھد

1.11 وماشروھن بالمعروف

1.12 یمحق اللّٰہ الربوویر بی الصمدقات

1.13 واصبر علی ما اصابک

1.14 وقولو قولا سدیدا

1.15 ان الدین عند اللّٰہ السلام

(ب) سنت

-1 سنت کی اہمیت

-2 دس منتخب احادیث مع ترجمہ و تشریح

-1 انما الاعمال بالنیات

-2 انما بعثت لاتمم مکارم الاخلاق

-3 لا یومن احدکم حتی یحب لاخیہ ما یحب لنفسہ

-4 المسلم من سلم المسلمون من سنہ المسمون من لسانہ ویدہ

-5 قل امنت باللہ ثم استقم

-6 خیرکم خیرکم لاہلہ

-7 سباب المسلم فسوق وقتالہ کفر

-8 المومن اخو المومن

-9 کل المسلم علی المسلم حرام دمہ وما لہ وعرضہ

-10 ایتہ المنافق ثلاث اذا حدث کذب واذا وعد اخلف واذا اوتمن خان

دین اسلام

2.1 اسلام کے بنیادی مقاصد کی وضاحت اور انسان کی انفرادی و اجتماعی زندگی پر ان کے اثرات

-1 توحید

-2 رسالت

-3 آخرت

-4 ملائکہ

-5 آسمانی کتب

2.2 عبادات

-1 نماز 2- روزہ 3- حج 4- زکوٰۃ

مندرجہ بالا عبادات کی اہمیت و فضیلت، حکمتیں اور انسان کی انفرادی و معاشرتی زندگی پر ان کے اثرات

حصہ اول

حصہ اسلامیت

تدریسی مقاصد

۱۔ قرآن مجید

عمومی مقصد: طالب علم یہ سمجھنے کے قابل ہو کہ اسلام کی تعلیمات کا اصل سرچشمہ قرآن مجید ہے

خصوصی مقاصد: طالب علم اس قابل ہو جائے گا کہ

- ☆ قرآن مجید کی تعریف کر سکے گا
- ☆ قرآن مجید کے نزول کی صورت بیان کر سکے
- ☆ قرآن مجید کی کی درجنی سورتوں کی پہچان کر سکے
- ☆ منتخب آیات کا ترجمہ و تشریح کر سکے

عمومی مقصد: یہ سمجھنے کے قابل ہو جائے گا کہ منتخب قرآنی آیات کے ذریعے اسلامی تعلیمات کا مفہوم کیا ہے

- ☆ قرآنی آیات کا ترجمہ تشریح کر سکے
- ☆ قرآنی تعلیمات کی روشنی میں اپنی اور معاشرتی اصلاح کر سکے

2. سنت

عمومی مقصد: طالب علم سنت نبوی کی اہمیت اور ضرورت کو اچھی طرح سمجھنے کے قابل ہو جائے گا

خصوصی مقصد:

- ☆ سنت کی تعریف بیان کر سکے
- ☆ سنت کی اہمیت و ضرورت کی وضاحت کر سکے
- ☆ سنت کی روشنی میں اسوہ حسنہ پر عمل کر سکے

3. منتخب احادیث نبویہ

عمومی مقصد: احادیث کی روشنی میں اخلاقی اقدار سے آگاہی حاصل کر سکے

خصوصی مقصد: احادیث کا ترجمہ و تشریح کر سکے

رسول اللہ ﷺ کے اسوۂ حسنہ کی پیروی کا جذبہ پیدا ہو سکے

-4 دین اسلام

عمومی مقاصد: دین اسلام کے بنیادی مقاصد اور عبادات کے بارے میں جان سکے اور بیان کر سکے

خصوصی مقاصد

لفظ دین اسلام کے لغوی اور اصطلاحی معنی بیان کر سکے

اسلام کے بنیادی مقاصد کی اہمیت بیان کر سکے

اسلام کے بنیادی مقاصد سے انسان کی انفرادی و اجتماعی زندگی پر پڑنے والے اثرات بیان کر سکے

عبادت کے لغظی و اصطلاحی معنی بیان کر سکے

عقیدے اور عبادت کا فرق بیان کر سکے

عبادات (نماز، روزہ، حج، زکواۃ) کے فوری اشکلات اور انسانی زندگی پر ان کی اثرات بیان کر سکے

اسلامی مقاصد و عبادات کے مطابق اپنی زندگی ڈھال کر ایک اچھا مسلمان بن سکے

(غیر مسلم طلباء کے لئے)

نصاب اخلاقیات سال اول — GEN 101

حصہ دوم مطالعہ پاکستان

ک	ع	ت
1	0	1

کل وقت-30 گھنٹے

موضوعات

اخلاقیات کی تعریف اور اہمیت

اخلاقیات کا معیار (قانون، عقل، الہی کتب)

مندرجہ ذیل اخلاق کی وضاحت

- ☆ دیانت داری
- ☆ وعدہ داری
- ☆ نظم و ضبط
- ☆ راست گوئی
- ☆ صبر و استقلال
- ☆ حوصلہ مندی
- ☆ وقت کی پابندی
- ☆ صفائی
- ☆ ایثار
- ☆ باہمی احترام
- ☆ مصلحت

نصاب اخلاقیات (سال اول)

تدریسی مقاصد

عمومی مقاصد: اعلیٰ اخلاق کی وجہ سے ملکی ترقی میں مثبت قدر اضافہ کر سکے

خصوصی مقاصد: طالب اس علم سے اس قابل ہو گا کہ

- ☆ موضوعات کا مطلب بیان کر سکے
- ☆ عملی زندگی سے مثالوں کی نشاندہی کر سکے
- ☆ اپنی شخصیت اور معاشرے پر موضوعات کے مثبت اثرات پیدا کرنے کے طریقے بیان کر سکے
- ☆ وراثت داری کی اہمیت بیان کر سکے
- ☆ وفاداری کی اہمیت بیان کر سکے
- ☆ نظم و ضبط کی افادیت بیان کر سکے
- ☆ صدق بیان کی ضرورت بیان کر سکے
- ☆ حوصلہ مندی کے فوائد بیان کر سکے
- ☆ وقت کی پابندی کے فوائد بیان کر سکے
- ☆ صفائی اور باہمی اختیار سے حسن کارکردگی کو بیان کر سکے
- ☆ مصلحت کے فوائد بیان کر سکے

نصاب (سال اول) Gen III

حصہ دوم | مطالعہ پاکستان | کل وقت 2 گھنٹے

موضوعات

☆ حریت فکر : مسلمان قوم میں آزادی فکر کی تاریخ مسلمانوں میں سیاسی آزادی کی اہمیت اور ضرورت - ذاتی، جماعتی اور ملکی غلامی کے نقصانات

☆ نظریہ پاکستان

قیام پاکستان کی اساس (دین اسلام) قیام پاکستان کی غرض و غایت نظریہ پاکستان کی وضاحت نظریہ پاکستان اور مسلم اقبال اور قائداعظم کے ارشادات کی روشنی میں

☆ نظریہ پاکستان کا تاریخی پس منظر

محمد بن قاسم کی آمد - مجدد الف ثانی اور شاہ ولی اللہ کی تبلیغی خدمات سید احمد شہید کی تحریک مجاہدین

☆ تعلیمی تحریکیں

علی گڑھ - ندوۃ العلماء (لکھنؤ) - مدرسۃ الاسلام - (کراچی) اسلامیہ کالج (پشاور) انجمن حمایت اسلام (لاہور)

مطالعہ پاکستان (حصہ دوئم)

تدریسی مقاصد

حریت فکر:

عمومی مقصد

طالب علم یہ جان لے کہ اسلام میں اور مسلمان قوم میں آزادی فکر کی کیا اہمیت ہے

خصوصی مقاصد

☆ حریت فکر کا معنی و مفہوم بیان کر سکے

☆ آزادی فکر کی اہمیت بیان کر سکے

☆ خصوصاً اسلام میں آزادی اظہار رائے کی اہمیت بیان کر سکے

☆ ذہنی غلامی کے قومی سطح پر نقصانات کے بیان کر سکے

☆ جسمانی غلامی قومی سطح پر نقصانات بیان کر سکے

نظریہ پاکستان

عمومی مقصد:

نظریہ پاکستان (دین اسلام) سے پوری طرح واقفیت ہو جائے

خصوصی مقاصد:

☆ نظریہ کی تعریف بیان کر سکے اور اس کی وضاحت کر سکے

☆ نظریہ پاکستان کی تعریف کر سکے اور اس کا مفہوم بیان کر سکے

☆ علامہ اقبال اور قائداعظم کے فرمودات کی روشنی میں نظریہ پاکستان بیان کر سکے

نظریہ پاکستان کا تاریخی پہلو

عمومی مقصد

☆ نظریہ پاکستان کے تاریخی پس منظر سے واقفیت حاصل کر سکے

خصوصی مقاصد:

☆ محمد بن قاسم کے بارے میں بیان کر سکے

- محمد بن قاسم کے ہندوستان پر حملہ کی وجہ بیان کر سکے
- محمد بن قاسم کے ہندوستان پر حملہ کے اثرات بیان کر سکے
- بیان کر سکے کہ ہندوستان میں ہندو مسلم دو قومی نظریہ کا نکتہ آغاز کیا ہے
- مجدد الف ثانی کی علمی خدمات بیان کر سکے
- شاہ ولی اللہ کی علمی خدمات بیان کر سکے
- مجدد الف ثانی اور شاہ ولی اللہ نے جو تبلیغ دین اور مسلمانوں میں سیاسی شعور پیدا کیا اسے بیان کر سکے

علمی تحریکیں

عمومی مقصد

- برصغیر کی علمی تحریکوں سے آگاہی حاصل ہو سکے

خصوصی مقاصد:

- علی گڑھ - دیوبند - ندوۃ العلماء مدرسۃ السلام ، اسلامیہ کالج۔ انجمن حمایت اسلام نے تعلیم کے ذریعہ سیاسی شعور مسلمانوں میں پیدا کیا اسے بیان کر سکے
- آزادی ہند کے سلسلہ میں تحریک مجاہدین کی خدمات بیان کر سکے

Eng-112 ENGLISH

Total contact hours

		T	P	C
Theory	64			
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 hours**

1.1 First eight essays of Intermediate English Book-II

2 CLOZE TEST **4 hours**

2.1 A passage comprising 50-100 words will be selected from the text. Every 11th word or any word for that matter will be omitted. The number of missing 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 hours**

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 hours**

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.

4 hours

5. TRANSLATION **6 hours**

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

Eng-112 ENGLISH

INSTRUCTIONAL OBJECTIVES

PAPER-A

1. DEMONSTRATE BETTER READING, COMPREHENSION AND VOCABULARY

1.1 Manipulate, skimming and scanning of the text.
1.2 Identify new ideas.
1.3 Reproduce facts, characters in own words
1.4 Write summary of stories

2. UNDERSTAND FACTS OF THE TEXT

2.1 Rewrite words to fill in the blanks recalling the text.
2.2 Use own words to fill in the blanks.

PAPER-B

3. APPLY THE RULES OF GRAMMAR IN WRITING AND SPEAKING

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

4. APPLY THE CONCEPTS OF COMPOSITION WRITING TO PRACTICAL SITUATIONS

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

5. APPLIES RULES OF TRANSLATION

5.1 Describe confusion.
5.2 Describe rules of translation.
5.3 Use rules of translation from Urdu to English in simple paragraph and sentences.

Math-113 APPLIED MATHEMATICS

Total contact hours 96	**T**	**P**	**C**
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 StandardForm
1.2 Solution
1.3 Nature of roots
1.4 Sum & Productof 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 centralAngle
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 INDENTITIES **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 I, j, 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 a x b.
11.10 Problems.

12 MATRICES AND DETERMINANTS **9 Hrs**

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

REFERENCE BOOKS

Applied Mathematics Math-113, by Nasir -ud-Din Mahmood, Sana-ullah Khan, Tahir Hameed, Syed Tanvir Haider, Javed Iqbal, Vol - I, National Book Foundation

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 solvingthe 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: (n,0), (n,1)……..(n,r),…….(n,n)
4.3 Derive expression for the general term.
4.4 Calculate the specified terms.
4.5 Expand a binomial of a given index. -
4.6 Extract the specified roots
4.7 Compute the approximate value to a given decimal place.
4.8 Solve problems involving binomials.

5 RESOLVE A SINGLE FRACTIONINTO PARTIALFRACTIONS USINGDIFFERENT 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 TRIGONOMETRICFUNCTIONS

7.1 Define the basic trigonometric functions/ratios of an angle as ratios of the sidesof 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 TECHNOLOGICALPROBLEMS

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 sins 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, VOLUMEAND 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 of these solids.

11. USE THE CONCEPT AND PRINCIPLES OF VECTORS IN SOLVINGTECHNOLOGICAL 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, directionconsines of a vector.
11.6 Derive analytic expression for dot product and cross product of two vector.
11.7 Deduce conditions of perpendicularly and parallelism of two vectors.
11.8 Solve problems

12. USE THE CONCEPT OFMATRICES & DETERMINANTS IN SOLVING TECHNOLOGICAL PROBLEMS

12.1 Define a matrix and a determinant.
12.2 List types of matrices.
12.3 Define transpose, ad joint and inverse of a matrix.
12.4 State properties of determinants.
12.5 Explain basic concepts.
12.6 Explain algebra of matrices.
12.7 Solve linear equation by matrices.
12.8 Explain the solution of a determinant.
12.9 Use Crammers Rule for solving linear equations

Phy-122: APPLIED PHYSICS

T	P	C
1	3	2

Total Contact Hours

Theory: 32
Practical 96

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

COURSE CONTENTS

1. MEASUREMENTS 2 Hours

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

2. SCALARS AND VECTORS

3 Hours

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

3. MOTION 4 Hours

1.1 Review of laws and equations of motion
1.2 Law of conservation of momentum
1.3 Angular motion
1.4 Relation between linear and angular motion
1.5 Centripetal acceleration and force
1.6 Equations of angular motion

4. TORQUE, EQUILIBRIUM AND ROTATIONAL INETRTIA 4 Hours

4.1 Torque
4.2 Centre of gravity and centre of mass
4.3 Equilibrium and its conditions
4.4 Torque and angular acceleration
4.5 Rotational inertia

5. WAVE MOTION 4 Hours

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

6. SOUND 5 Hours

6.1 Longitudinal waves
6.2 Intensity, loudness, pitch and quality of sound
6.3 Units of Intensity of level and frequency response of ear
6.4 Interference of sound waves silence zones, beats
6.5 Acoustics
6.6 Doppler effect.

7. LIGHT 2 Hours

7.1 Review laws of reflection and refraction
7.2 Image formation by mirrors and lenses
7.3 Optical instruments
7.4 Wave theory of light
7.5 Interference, diffraction, polarization of light waves
7.6 Applications of polarization in sunglasses, optical activity and stress analysis

8. OPTICAL FIBER 3 Hours

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

9. LASERS 4 Hours

9.1 Corpuscular theory of light
9.2 Emission and absorption of light
9.3 Stimulated absorption and emission of light
9.4 Laser principle
9.5 Structure and working of lasers

9.6 Types of lasers with brief description.
9.7 Applications (basic concepts)
9.8 Material processing
9.9 Laser welding
9.10 Laser assisted machining
9.11 Micro machining
9.12 Drilling, scribing and marking
9.13 Printing
9.14 Lasers in medicines

RECOMMENDED BOOKS

1. Tahir Hussain, Fundamentals of Physics Vol-I and II.
2. Farid Khawaja, Fundamentals of Physics Vol-I and II.
3. Wells and Slusher, Schaum's Series Physics.
4. Nelkon and Oyborn, Advanced Level Practical Physics
5. Mehboob Ilahi Malik and Inam-ul-Haq, Practical Physics
6. Wilson, Lasers – Principles and Applications.
7. M. Aslam Khan and M. Akram Sandhu, Experimental Physics Note Book.

Phy-122: APPLIED PHYSICS

INSTRUCTIONAL OBJECTIVES

1. USE CONCEPTS OF MEASUREMENT TO PRACTICAL SITUATIONS AND TECHNOLOGICAL PROBLEMS.

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

2. USE CONCEPTS OF SCALARS AND VECTORS IN SOLVING PROBLEMS INVOLVING THESE CONCEPTS.

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

3. USE THE LAW OF CONSERVATION OF MOMENTUM AND CONCEPTS OF ANGULAR MOTION TO PRACTICAL SITUATIONS.

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

4. USE CONCEPTS OF TORQUE, EQUILIBRIUM AND ROTATIONAL INERTIA TO PRACTICAL SITUATION/PROBLEMS.

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

5. USE CONCEPTS OF WAVE MOTION IN SOLVING RELEVANT PROBLEMS.

5.1 Explain Hooke's Law of Electricity
5.2 Derive formula for Motion under an elastic restoring force
5.3 Derive formulae for simple harmonic motion and simple pendulum
5.4 Explain wave form with reference to S.H.M. and circular motion
5.5 Explain Resonance
5.6 Explain transverse vibration of a stretched string
5.7 Use the above concepts and formulae of S.H.M. to solve relevant problems.

6. UNDERSTAND CONCEPTS OF SOUND

6.1 Describe longitudinal wave and its propagation
6.2 Explain the concepts: Intensity, loudness, pitch and quality of sound
6.3 Explain units of Intensity of level and frequency response of ear
6.4 Explain phenomena of silence zones, beats
6.5 Explain Acoustics of buildings
6.6 Explain Doppler effect giving mathematical expressions.

7. USE THE CONCEPTS OF GEOMETRICAL OPTICS TO MIRRORS AND LENSES.

7.1 Explain laws of reflection and refraction
7.2 Use mirror formula to solve problems
7.3 Use the concepts of image formation by mirrors and lenses to describe working of optical instruments, e.g. microscopes, telescopes, camera and sextant.

8. UNDERSTAND WAVE THEORY OF LIGHT

8.1 Explain wave theory of light
8.2 Explain phenomena of interference, diffraction, polarization of light waves
8.3 Describe uses of polarization given in the course contents.

9. UNDERSTAND THE STRUCTURE, WORKING AND USES OF OPTICAL FIBER

9.1 Explain the structure of the Optical Fiber
9.2 Explain its principle of working
9.3 Describe use of optical fiber in industry and medicine

10. UNDERSTAND THE STRUCTURE, WORKING, AND USES OF LASERS

10.1 Explain the stimulated emission of radiation
10.2 Explain the laser principle
10.3 Describe the structure and working of lasers
10.4 Distinguish between types of lasers
10.5 Describe the applications of lasers in the fields mentioned in the course contents.

Phy-122: APPLIED MECHANICS

LIST OF PRACTICALS 96 Hours

1. Draw graphs representing the functions:
   (a) $y = mx$ for $m = 0, 0.5, 1, 2$
   (b) $y = x^2$
   (c) $y = 1/x$
2. Find the volume of a given solid cylinder using vernier callipers.
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 forces using Grave-sands apparatus.
6. Verify law of triangle of forces and Lami's theorem
7. Determine the weight of a given body using
   (a) Law of parallelogram of forces
   (b) Law of triangle of forces
   (c) Lami's theorem
8. Verify law of polygon of forces using Grave-sands apparatus.
9. Locate the position and magnitude of resultant of like parallel forces.
10. Determine the resultant of two unlike parallel forces.
11. Find the weight of a given body using principle of moments.
12. Locate the centre of gravity of regular and irregular shaped bodies.
13. Find Young's Modules of Elasticity of a metallic wire.
14. Verify Hooke'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 resonance of air column in resonance tube and find velocity of sound.
18. Find the frequency of the given tuning fork using resonance tube.
19. Find velocity of sound in rod by Kundt's tube.
20. Verify rectilinear propagation of light and study shadow formation.
21. Study effect of rotation of plane mirror on reflection.
22. Compare the refractive indices of given glass slabs.
23. Find focal length of concave mirror by locating centre 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 apparent depth.
27. Find refractive index of glass by spectrometer.
28. Find focal length of converging lens by plane mirror.
29. Find focal length of converging lens by displacement method.
30. Find focal length of diverging lense 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 (magnification glass)
34. Find angular magnification of a compound microscope.
35. Study working and structure of camera

36. Study working and structure of sextant
37. Compare the different scales of temperature and verify the conversion formula.
38. Determine the specific heat of lead shots.
39. Find the coefficient of linear 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

		T	P	C
Total Contact Hours 128				
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.
3. Know the scientific methods for production, and use of materials of industrial & technological significance.
4. Gains skill for the efficient conduct of Practical in a chemistry lab.

2 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**

Interoduction

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 **1 Hours**

Introduction

Classification

Properties of lubricants

Selection of lubricants

17. POLLUTION **1 Hours**

The problems and its dangers

Causes of pollution

Remedies to combat the hazards of pollution

3 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 fadio activity

Differentiate between alpha, beta and gama 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

Ch-112: APPLIED CHEMISTRY

LIST OF PRACTICALS

96 Hours

On completion of this course, the trainees will be able to;

1. To introduce the common apparatus, glassware and chemical reagents used in the chemistry lab.
2. To purify a chemical substance by crystallization.
3. To separate a mixture of sand and salt.
4. To find the melting point of substance.
5. To find the pH of a solution with pH paper.
6. To separate a mixture of inks by chromatography.
7. To determine the co-efficient of viscosity of benzene with the help of Ostwald's vasomotor.
8. To find the surface tension of a liquid with a stalagmometer.
9. To perform electrolysis of water to produce Hydrogen and Oxygen.
10. To determine the chemical equivalent of copper by electrolysis of Cu SO_4.
11. Determination of Heat of Neutralization of NaOH and HCl.
12. Determination of Heat of Solution of C_2H_5OH and H_2O.
13. Determination of %age of O_2 in air.
14. Determination of %age of N_2 in air.
15. Determination of %age of CO_2 in air.
16. To get introduction with the methods/apparatus of conducting volumetric estimation.
17. To prepare standard solution of a substance.
18. To find the strength of a given alkali solution.
19. To estimate HCO_3^{-1} contents in water.
20. To estimate Cl^{-1} contents in water.
21. To estimate SO_4^{-2} contents in water.
22. To estimate total solids in water.
23. To find out the %age composition of a mixture solution of KNO_3 and KOH volumetrically.
24. To find out the amount of Na_2SO_4 and NaOH in their mixture with titration method.
25. To find the boiling point of Freon-12, or R-134a and Freon-22.
26. To find the density of Freon-12, or R 134a and Freon-22 with the help of sp. gravity bottle.
27. To prepare Ammonia gas in Laboratory and perform its tests.
28. To get introduction with the scheme of analysis of salts for basic radicals.
29. To analyse Ist group radials (Ag^{+1}, Pb^{+2}, Hg^{+1}).
30. To exercise Practice for detection of Ist group radicals.
31. To detect and confirm II-A group radicals (Hg^{+2}, Pb^{+4}, Cu^{+2}, Bi^{+3}, Cd^{+2})
32. To detect and confirm II-B group radicals (AS^{+3}, Sb^{+3}, $Sn^{+2, +4}$)

RECOMMENDED BOOKS

1. Text Book of Intermediate Chemistry (Part I and II)
2. Sh. Atta Mohammad, Ilmi Applied Science.
3. J.N. Reddy, Polytechnic Chemistry, Tata Mc-Graw Hill Co., New Delhi.
4. Qammar Iqbal, Chemistry for Engineers and Technologists.

MT-111: TECHNICAL DRAWING

T	P	C
0	3	1

Total contact hours:

Practical 96 Hours

Prerequisites: Fundamental knowledge of drawing.

Aim: On completion of this course, the trainees will be able to;

1. Apply the different related knowledge, skills and attitudes in technical sketching and working drawing.
2. Teach the students how to graphically represents the refrigeration and air conditioning systems.
3. Draw visualization, sense of form and proportions of various forms of drawing.
4. Teach the students how to make layout, of ducting, piping etc.

COURSE CONTENTS

1. USES AND APPLICATION OF TECHNICAL DRAWING. 3 Hours

- 1.1 Introduction to technical drawing.
- 1.2 Uses of technical drawing.
- 1.3 Common drawing terms.
- 1.4 Application of drawing forms
- 1.5 Practice of conventions

2. DRAWING SCALES. 3 Hours

- 2.1 Importance and meaning of drawing scales.
- 2.2 Metric scale
- 2.3 Inch scale.
- 2.4 Applications of drawing scales**.**

3. SKETCHING TOOLS AND MATERIALS. 3 Hours

- 3.1 Types of drawing papers.
- 3.2 Care and maintenance of sketching tools, materials (sheet format, title block, wateress and boarder line.)

4. FREEHAND LINE SKETCHING 6 Hours

- 4.1 Introduction to sketching techniques.
- 4.2 Sketching of horizontal lines.
- 4.3 Sketching of vertical lines.
- 4.4 Sketching arcs and circles.
- 4.5 Sketching ellipses and conic sections.
- 4.6 Projections in sketching.
- 4.7 Sketching of objects.

5. LETTERING. 6 Hours

- 5.1 Importance of good lettering.

5.2 Letter strokes.
5.3 Letter guidelines.
5.4 Composition of lettering.
5.5 Lettering Practice.

6 ALPHABET OF LINES. 3 Hours

6.1 Importance of alphabet of lines.
6.2 Common alphabet of lines.
6.3 Apply the alphabet of lines in drafting.

7. INTRODUCTION TO PICTORIAL DRAWING. 6 Hours

7.1 Uses of pictorial views.
7.2 Three types of pictorial views.
7.3 Proportion in pictorial sketching.
7.4 Draw pictorial views of given objects.

8. INTRODUCTION TO MULTI-VIEW SKETCHING. 9 Hours

8.1 Concept of multi-view drawing.
8.2 Explain principal views.
8.3 Draw principal plane of projections.
8.4 Draw projectors/projection lines.
8.5 Draw multi-views of machine components.

9. BASIC DIMENSIONING SYSTEMS 6 Hours

9.1 Definition of dimensions.
9.2 Two types of dimensions
9.3 Systems of measurement.
9.4 Draw dimensional multi-views.
9.5 Practice dimensioning of holes, arcs, and circles.
9.6 Practice dimensioning of angles.
9.7 Notes and specifications.
9.8 Rules in dimensioning.
9.9 Practice dimensioning systems.

10. GEOMETRICAL CONSTRUCTION. 9 Hours

10.1 Importance of geometry.
10.2 Definition of terms used in geometrical construction.
10.3 Basic geometrical constructions.
10.4 Draw tangents of geometrical constructions.
10.5 Drawings of selected component features.

11. WORKING DRAWINGS. 12 Hours

11.1 Uses of working drawing.
11.2 Preliminary design sketching.
11.3 Draw detail drawing
11.4 Draw assembly drawing.
11.5 Draw working drawings of machine elements/components.

12. PICTORIAL DRAWINGS. 12 Hours

12.1 Concept of sectioning.
12.2 Material symbols used in sectioning.
12.3 Types of sections.,
(a) Full section (b) Half section
(c) Removed section (d) Broken section.
(e) Phantom section (f) off-set-section.
12.4 Draw sectional views of machine components.

13. PICTORIAL DRAWINGS. 9 Hours

13.1 Importance of isometric views.
13.2 Types of isometric views.
13.3 Draw isometric views of arcs and circles.
13.4 Draw oblique view of rectangular- block.
13.5 Draw Isometric views of objects/component parts.

14. AUXILIARY DRAWING 9 Hours

14.1 Uses and applications of AUXILIARY views.
14.2 Draw Primary AUXILIARY view, frontal projections.
14.3 Draw Primary AUXILIARY view, horizontal projections.
14.4 Draw Primary AUXILIARY view, profile projections.
14.5 Draw True length of a line in the AUXILIARY views.
14.6 Secondary auxiliary views.
14.7 Draw auxiliary views of objects/component parts.

BOOKS RECOMMENDED.

1. Engineering Drawing. by French & Vierck.
2. Geometrical Drawing by N.D. Bhatt.
3. Ist Year Engineering Drawing by A.C. Parkinson.

ET-113: APPLIED ELECTRICITY

T	P	C
2	3	3

Total Contact hours

Theory 64 Hours
Practical 96 Hours

Prerequisites: Knowledge of Physics at Secondary School Level.

AIM: To enable the student to acquire knowledge of basic principles of electricity and magnetism

COURSE CONTENTS.

1. ELECTRICITY FUNDAMENTALS. 3 Hours

- 1.1 Modern electron theory
- 1.2 Concept of free electrons
- 1.3 Electric potential
- 1.4 Electron flow as current, unit
- 1.5 Static electricity
- 1.6 Types of currents – AC and DC
- 1.7 Voltage, unit
- 1.8 Resistance, units
- 1.9 Review of Cardio-Pulmonary Resuscitation (CPR)

2. OHM'S LAW AND TYPES OF CIRCUIT. 7 Hours

- 2.1 Ohm's Law
- 2.2 Series circuits, characteristics and uses
- 2.3 Parallel circuits, characteristics and uses
- 2.4 Series-parallel circuits, solution of simple circuit problems.
- 2.5 Voltage drop
- 2.6 Electric power, equations and units
- 2.7 Alternating current cycle, time period, frequency and its unit.
- 2.8 Values of AC-instantaneous, rms, peak and their relations

3. ELECTRIC CIRCUIT FUNDAMENTALS AND ELECT. METERS 4 Hours

- 3.1 Symbols used in elect. Circuits
- 3.2 Measurement of current, voltage and resistance by meters.
- 3.3 Measurement of power by wattmeter.
- 3.4 Tong tester & its use
- 3.5 Use of multimeter
- 3.6 Types of elect. materials

4. APPLICATION OF KIRCHHOFF'S LAW 4 Hours

- 4.1 Kirchhoff's current and voltage laws
- 4.2 Problem solving.

5. MAGNETISM AND ELECTRO MAGNETISM 5 Hours

- 5.1 Theory of magnetism
- 5.2 Properties of magnets, units of flux, flux density
- 5.3 Electromagnetism, units of magnetizing force and field strength

5.4 Magnetic field strength, Ampere-turns
5.5 Solenoid, uses in HVAC&R systems.
5.6 Polarity of electromagnetism, Right Hand Rules
5.7 Electromagnetic induction, Faraday's Laws, Lenz's Law
5.8 Permeability, Reluctance, their units
5.9 Motor action between two magnetic fields.
5.10 Fleming's Left Hand Rule.

6. CAPACITORS AND INDUCTORS 5 Hours

6.1 Capacitance, its units and types
6.2 Combination of capacitors in series and parallel
6.3 Use of capacitors in HVAC&R electric circuitry systems.
6.4 Inductance and its unit
6.5 Back emf
6.6 Inductive reactance and units

7. D.C. GENERATOR 5 Hours

7.1 Electrical generator, basic principles
7.2 Construction, field, armature, yoke, commutator, brushes etc.
7.3 EMF equation
7.4 Types of DC Generators and their uses.

8. ELECTRIC MOTOR USED ON REFRIGERATION EQUIPMENT 10 Hours

8.1 Introduction of induction motors
8.2 Principle of induction motors
8.3 Basic types of motors.
8.4 Single phase motors
  a. Split phase induction motor
  b. Capacitor start induction motors (CSIR, CSR & PSC motors)
  c. Repulsion start induction motor
  d. Shaded pole motor.
8.5 Three phase motors

9. ALTERNATOR 6 Hours

9.1 Principle of alternator
9.2 Construction of alternator
9.3 E.M.F. equation of alternator
9.4 Excitation of alternators

10. TRANSFORMERS 4 Hours

10.1 Principle of operation, construction
10.2 Primary and secondary windings and voltages
10.3 Step up and step down transformer.
10.4 Current ratios in each case

11. TYPES AND USE OF WIRING 3 Hours

11.1 Cleat wiring.
11.2 Batten wring.

11.3 Conduit wiring
11.4 Earthing.

12. TYPES OF WIRE AND CABLES 4 Hours

12.1 V.I.R. cables.
12.2 P.V.C. cables.
12.3 Multi-core cables
12.4 Flexible cables.
12.5 Lead sheathed cables.
12.6 Paper insulated cables.
12.7 Varnish cambric cables.
12.8 Mineral insulated cables.
12.9 Uses of cables.

13. ELECTRICAL ACCESSORIES. 4 Hours

13.1 Starters.
13.2 Magnetic contactors.
13.3 Stabilizer
13.4 Circuit breakers.
13.5 Time delay relay
13.6 Timers.

RECOMMENDED BOOKS

1. Althous - Modern Refrigerating and Air conditioning
2. B.L. Theraja - Electrical Technology

ET-113: APPLIED ELECTRICITY

INSTRUCTIONAL OBJECTIVES:

On completion of this course, the student will be able to:

1. UNDERSTAND THE ELECTRICITY FUNDAMENTALS.

1.1 Define electron theory of electricity
1.2 Define resistance, current and voltage.
1.3 Enlist types of electricity.
1.4 Enlist the methods of generation of electricity
1.5 Define electrostatic electricity.
1.6 State the difference between direct and alternative current.

2. UNDERSTAND THE OHM'S LAW AND COMBINATION OF RESISTANCES

2.1 Define ohm's law
2.2 Describe series and parallel circuits.
2.3 Explain series and parallel circuits (Combined).
2.4 Apply ohm's law in series and parallel circuits for simple problem solving.
2.5 Determine voltage drop in series, parallel and series- parallel circuits.
2.6 Define power losses.
2.7 Explain alternating current.
2.8 State the values of A.C.
2.9 State the relations between different values of AC.
2.10 Define frequency, time period & cycle.

3. UNDERSTAND THE FUNDAMENTALS OF ELECTRIC CIRCUITS, ELECTRICAL MATERIALS AND USE OF ELECTRICAL METERS.

3.1 State difference between electrical circuits (series & parallel).
3.2 Draw symbols used in elect. Circuits.
3.3 State the use of volt meter, ampere meter and ohm meter.
3.4 State the use of wattmeter.
3.5 Make the connections of basic instruments, (Ammeter, Voltmeter & Watt meter).
3.6 State the use of tong tester and multimeter.
3.7 Define conductor, semi conductor and insulator.

4. UNDERSTAND THE APPLICATION OF KIRCHHOFF'S LAW

4.1 Define Kirchhoff's current law.
4.2 Define Kirchhoff's voltage law.
4.3 Apply Kirchhoff's laws in solving simple problems.

5. UNDERSTAND MAGNETISM AND ELECTROMAGNETISM

5.1 State theory of magnetism.
5.2 State the properties of magnetism and units of flux, flux density.
5.3 Define electromagnetism and units of field strength and magnetizing force.

5.4 Define magnetic field strength and amp-turn.
5.5 Explain electromagnetic induction and Faraday's Laws.
5.6 Explain the working principle of a solenoid and its uses in HVAC&R circuitry systems.
5.7 Define permeability & its unit.
5.8 Define reluctance and its unit.
5.9 Explain motor action between two magnetic fields and Fleming's Left Hand Rule.

6. UNDERSTAND THE APPLICATION OF CAPACITORS AND INDUCTORS IN HVAC&R SYSTEMS.

6.1 Define capacitance and its unit.
6.2 State formulae for combining capacitors in series and parallel
6.3 Explain the types and uses of capacitors in HVAC&R electric circuitry systems.
6.4 Define inductance and its unit
6.5 Define back emf
6.6 Explain the inductive reactance and unit.

7. UNDERSTAND FUNDAMENTALS OF ELECTRICAL GENERATORS.

7.1 Explain the working principle of DC Generator
7.2 State the construction of a DC Generator
7.3 State emf equation
7.4 State the types of DC Generators and their uses.
7.5 State the use of commutator.

8 UNDERSTAND WORKING OF ELECTRICAL MOTORS USED ON REFRIGERATION EQUIPMENT.

8.1 Define induction motors
8.2 Explain the principle of induction motors
8.3 Enlist and define the two basic types of electric motors
8.4 Describe single phase induction motors, their types, rating and uses.
  a. Split phase induction motor
  b. Capacitor start induction motors (CSIR, CSR & PSC motors)
  c. Repulsion start induction motor.
  d. Shaded pole motor.
8.5 Explain 3-phase induction motors and their uses.
8.6 Draw circuit diagrams of all AC motors used on refrigeration equipment.

9 UNDERSTAND THE FUNCTION AND CONSTRUCTION OF AN ALTERNATOR

9.1 State the principle of an alternator.
9.2 Explain the construction of an alternator.
9.3 Derive the E.M.F. equation of an alternator.
9.4 Explain the efficiency of an alternator.
9.5 State how alternators are excited.

10. UNDERSTAND THE TRANSFORMER AND ITS APPLICATION

10.1 State the principle of transformers.

10.2 Enlist the types of transformer.
10.3 Explain primary and secondary windings and the relation between their voltages.
10.4 State step up and step down transformer.
10.5 Explain the current ratios in both types of transformers.

11. UNDERSTAND THE TYPES AND USES OF WIRING SYSTEMS

11.1 Enlist the types of wiring.
11.2 State cleat wiring method and uses.
11.3 State batten wiring method and uses.
11.4 State conduit wiring (surface & concealed) method and uses.
11.5 State the need of earthing.
11.6 State the methods of earthing.

12 UNDERSTAND THE TYPES OF WIRES AND CABLES.

12.1 Distinguish between wire and cables.
12.2 Explain current and voltage ratings of wires and cables.
12.3 Enlist the types of cables.
12.4 State properties and uses of V.I.R. cable.
12.5 State properties and uses of P.V.C. cable.
12.6 State the construction and uses of multicore cables.
12.7 State the sizes and ratings of flexible cable.
12.8 State the ratings and uses of lead sheathed and paper insulated cables.
12.9 Distinguish between varnish cambric cables and mineral insulated cables.
12.10 State the current ratings of 1/.044, 3/.029, 3/.036, 7/.029, 7/.036 and 7/.044 cables.

13 UNDERSTAND THE ELECTRICAL ACCESSORIES WHICH ARE COMMONLY USED IN AIR-CONDITIONING INDUSTRY.

13.1 State the purpose of starter and its use with electrical motor above 5 H.P.
13.2 Explain the construction of magnetic contactor and its use in single and three phase circuit.
13.3 Explain the function and working principle of circuit breaker.
13.4 Explain the use and function of time relay.
13.5 Explain the use and function of DOL and Star-delta starters.
13.6 Draw circuit diagrams of motors with electric accessories connected with them.

ET-113: APPLIED ELECTRICITY.

LIST OF PRACTICALS Total - 96 Hours

On completion of this course, the trainees will be able to;

1. Make a simple twist joint of P.V.C cable No.1/0.044
2. Make a married joint of P.V.C cable No 7/0.036 or 7/0.029
3. Make pigtail joint of P.V.C Cable No 1/0.044.
4. Make a "tee" joint of P.V.C. Cable No 7/0.036 or 7/.029
5. Construct an electrical Test Box.
6. Wiring three loads (light bulbs) in a series circuit.
7. Wiring three loads (light bulbs) and a switch in a series circuit.
8. Wiring two loads (light bulbs) in series using a switch to turn them off and on, keeping a third light in the circuit on continuously.
9. Wiring three loads (light bulbs) in a parallel circuit.
10. Wiring three loads (light bulbs) in a parallel circuit and using a single-throw switch to control the circuit.
11. Wiring three loads (light bulbs) in parallel using a single-pole single-throw switch to turn two light bulbs off and leave one light bulb on all the time.
12. Wiring a series-parallel circuit with six light bulbs - three lights wired in parallel, and three light bulbs wired in series.
13. Wiring a series-parallel circuit with a single-pole single-throw switch controlling the total circuit, where three loads (light bulbs) are wired in parallel, and three loads (light bulbs) are wired in series.
14. Wiring a series-parallel circuit with a single-pole single-throw switch controlling the series circuit, where three loads (light bulbs) are wired in parallel.
15. Reading electrical meters.
16. Measuring resistance using Ohm's law.
17. Measurement of resistance of a given wire with the help of (VOM) voltmeter, ammeter (Method V=IR), Ohmmeter and wheat stone bridge.
18. Using a voltmeter to measure voltage and record voltage drop in a series circuit.
19. Using a voltmeter to measure voltage and record voltage drop in a parallel circuit.
20. Using a clamp-on ammeter to measure current in a series circuit.
21. Using a clamp-on ammeter to measure amperage in a parallel circuit.
22. Taking an in-line amperage reading with a VOM.
23. Checking the resistance at a series circuit with an ohmeter.
24. Checking the accuracy and calibration of electrical instruments.
25. Identify the types of electric motors used on Refrigeration equipment.
26. Draw an electric circuit diagram of a refrigerator with motor, capacitor, relay and overload.
27. Dismantling of capacitor start induction run motor.
28. Draw automatic motor control circuit diagram of single phase induction motor with speed-regulator switch.
29. Calculate the capacity of voltage stabilizer and its function.
30. Test motor starter.
31. Test an open type capacitor start electric motor.
32. Dismantle and assemble a single phase motor.
33. Assembling of capacitor start induction motor.
34. Trace the circuits and draw the wiring diagram for a commercial refrigerating system.
35. Evaluating the condition of a transformer with an ohmmeter.
36. Evaluating a transformer primary and secondary voltage.
37. Hooking a step down transformer to a relay contactor.
38. Checking a relay contactor with a voltmeter.
39. Checking a relay contactor with a ohmmeter.

40. Wiring a relay into a circuit.
41. Using a switching relay to control two loads in a circuit.
42. Verification of Kirchhoff's Law.
43. Verify current and voltage ratios in transformers.
44. Problem solving relating to theory topics

COMP-142 COMPUTER APPLICATIONS

Total Contact Hours		**T**	**P**	**C**
Theory:	**32Hrs**	**1**	**3**	**2**
Practical:	**96 Hrs**			

Pre-requisites: None

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

Course Contents:

ELECTRONIC DATA PROCESSING (E.D.P.) 6 Hrs

1.1 Basic Terms of Computer Science Data & its, types, Information, Hardware, Software
1.2 Computer & its types
1.3 Block diagram of a computer system
1.4 BIT, Byte, RAM & ROM
1.5 Input &Output devices
1.6 Secondary storage devices
1.7 Types of Software
1.8 Programming Languages
1.9 Applications of computer in different fields
1.10 Application in Engineering, Education & Business

MS-WINDOWS 2 Hrs

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

MS-OFFICE (MS-WORD) 8 Hrs

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

MS-OFFICE (MS-EXCEL) 9 Hrs

4.1 Introduction to MS-Excel & its Screen
4.2 Entering data & apply formulas in worksheet
4.3 Editing & Formatting the Cells, Row & Colum

4.4 Insert Graphs in sheet
4.5 Page setup, Print Preview & Printing
4.6 Types & Categories of Charts

MS. OFFICE (MS-POWER POINT) 4 Hrs

5.1 Introduction to MS-Power point
5.2 Creating a, presentation
5.3 Editing & formatting a text box
5.4 Adding pictures & colors to a slide
5.5 Making slide shows
5.6 Slide Transition

INTERNET & E-MAIL 3Hrs

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

COMP-142 COMPUTER APPLICATIONS

Instructional Objectives:

1. **UNDERSTAND ELECTRONIC DATA PROCESSING (E.D.P)**
   - 1.1. Describe Basic Terms of Computer Science.Data & its Types, Information, Hardware, Software
   - 1.2. Explain Computer & its types
   - 1.3. Explain Block diagram of a computer system
   - 1.4. State the terms such as BIT, Byte, RAM & ROM
   - 1.5. Identify Input & Output devices
   - 1.6. Describe Secondary Storage devices
   - 1.7. Explain Types of Software
   - 1.8. Introduction to Programming Language
   - 1.9. Explain Applications of computer in different fields
   - 1.10. Application in Engineering, Education & Business
2. **UNDERSTAND MS-WINDOWS**
   - 2.1 Explain Introduction to Windows
   - 2.2 Describe Loading & Shut down process
   - 2.3 Explain Introduction to Desktop items(Creation of Icons, Shortcut, Folder & modify Taskbar)
   - 2.4 Explain Desktop properties
   - 2.5 Describe Use' of Control Panel (add/remove program, time & date, mouse and create user account)
   - 2.6 Explain the method of searching a document
3. **UNDERSTAND MS-OFFICE (MS-WORD)**
   - 3.1 Explain Introduction to MS-Office
   - 3.2 Describe -Introduction to MS-Word & its Screen
   - 3.3 Describe create a new document
   - 3.4 Explain Editing & formatting the text
   - 3.5 Describe saving & Opening a document
   - 3.6 Explain Page setup, (Set the Margins & Paper)
   - 3.7 Describe Spell Check & Grammar
   - 3.8 Explain Paragraph Alignment
   - 3.9 Explain Inserting Page numbers, Symbols, Text box & Picture in the document
   - 3.10 Describe Use the different Format menu drop down commands(Drop Cap, Change Case, Bullet &Numbering and Border & Shading)
   - 3.11 Explain Insert the Table and its Editing and modification
   - 3.12 Describe printing the document
   - 3.13 Describe the method of file saving as a PDF Format
4. **UNDERSTAND MS-OFFICE (MS-EXCEL)**
   - 4.1 Explain Introduction to MS-Excel & its Screen
   - 4.2 Describe Entering data & apply formulas in worksheet
   - 4.3 Describe Editing &Formatting the, Cells, Row & Column
   - 4.4 Explain Insert Graphs in sheet
   - 4.5 Describe Page setup, Print preview & Printing
   - 4.6 Explain in details formulas for sum, subtract, multiply, divide, average
   - 4.7 Explain in details the types of charts e.g pie chart, bar chart
5. **UNDERSTAND MS-OFFICE (MS-POWER POINT)**
   - 5.1 Describe Introduction to MS-Power point
   - 5.2 Explain creating a presentation

5.3 Describe Editing & formatting a text box
5.4 Explain Adding pictures & colors to a slide
5.5 Describe Making slide shows
5.6 Explain Slide Transitions

6. UNDERSTAND INTERNET &E-MAIL

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

Recommended Textbooks:

1. **Bible Microsoft Office 2007 by John Walkenbach**
2. **Bible Microsoft Excel 2007 by John Walkenbach**
3. **Bible Microsoft PowerPoint 2007 by John Walkenbach**

COMP-142 COMPUTER APPLICATIONS

List of Practical:

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

MS WINDOWS XP **12 Hrs**

1.1 Practice of loading and shutdown of operating system
1.2 Creating items (icons, shortcut, folders etc) and modification taskbar
1.3 Changing of wallpaper, screensaver, and resolution
1.4 Practice of control panel items (add/remove, time and date,mouse, and create user account)

MS OFFICE (MS-WORD) **27 Hrs**

1.5 Identification the MS Word Screen and its menu
1.6 Practice of create a new document, saving and re-opening it fromthe location and spell check & grammar
1.7 Practice of Page Formatting (Borders, Character Spacing, Paragraph,Bullets & Numberings and Fonts)
1.8 Practice of different tool bars like standard, format& drawing tool bars
1.9 Practice of Insert pictures, clipart, and shapes
1.10 Practice of header and footer
1.11 Practice of insert table and also format of table
1.12 Practice of page setup, set the page margins, and printing documents

MS OFFICE (MS-EXCEL) **27 Hrs**

1.13 Identification the MS EXCEL Screen and its menu
1.14 Practice of create a new sheet, saving and re-opening it from the location and spell check
1.15 Practice of insert and delete of row and columns (format of cell)
1.16 Practice of entering data and formulas in worksheet(Add, SubtRACT, Multiplying, and Divide & Average)
1.17 Repeating Practical serial number04
1.18 Practice of insert chart and its types
1.19 Practice of page setup, set the page margins, and printing

MS OFFICE (MS-POWER POINT) **15 Hrs**

1.20 Identification the MS POWER POINT Screen and its menu
1.21 Practice of create a new presentation and save
1.22 Practice of open saves presentations
1.23 Practice of inset picture and videos

INTERNET & E-MAIL **12 Hrs**

1.24 Identification internet explorer
1.25 Practice of searching data from any search engine
1.26 Practice of create an E-Mail account and how to send and receivemails, download attachments

HVAC-113: PRINCIPLES OF REFRIGERATION

T	P	C
2	3	3

Total Contact hours

Theory 64 hours
Practical 96 hours

Prerequisites:
1. Fundamental knowledge of Basic Sciences.
2. Fundamental knowledge of Math.

AIMS: The students will be able to: -

1 Understand the basic principles of refrigeration.
2 State the principles of vapor compression used in refrigeration system.
3 Understand refrigeration cycle, its major components, their construction, operation and maintenance

COURSE CONTENTS

1 FUNDAMENTALS OF REFRIGERATION. 4 Hours

1.1 Energy, its types, Heat, its types, Specific heat, units of heat.
1.2 Temperature, Intensity of heat.
1.3 Methods of measuring temperature.
1.4 Laws of thermodynamics.
1.5 Methods of heat transfer.
1.6 Conversion of F.P.S System to SI (metric system)
1.7 Definition of Refrigeration
1.8 Scope of Refrigeration, Types of Refrigeration.
1.9 Problem Solving

2 SATURATED AND SUPER-HEATED VAPOURS. 6 Hours

2.1 Pressure, Dalton's Law of Partial Pressure, Pascal's law, Force & Work
2.2 Saturation temperature, saturated liquid, saturated vapors, sublimation, fusion, critical temperature, vaporization and evaporation, condensation.
2.3 Effect of pressure on saturation temperature and critical temperature.
2.4 Simple vapor compression cycle.
2.5 Condensing and evaporating temperature & pressure.
2.6 Superheated Vapors and Sub-cooling

3 IDEAL GAS LAWS 6 Hours

3.1 Effect of heat on Solid, Liquid and Gas
3.2 Pressure-temperature-volume relationship of gases.
3.3 Constant pressure process.
3.4 Pressure volume relationship at constant temperature.
3.5 Pressure temperature relationship at constant volume.
3.6 General gas law/equation.
3.7 Problem solving.

4 REFRIGERANTS 11 Hours

4.1 Refrigerant and their Properties
4.2 Common refrigerants.
4.3 Classification of refrigerants and their uses.
4.4 Study of group I, II, III, refrigerant, of each high and low side pressure.
4.5 Refrigerant cylinders, colour code for refrigerant cylinders, refrigerants oils.
4.6 Safe handling of refrigerants and compressed gases.
4.7 Selection and replacement of refrigerants
4.8 Introduction to HCFC Refrigerants
4.9 Suction, Discharge, Condensing & Evaporating Temperature and Pressure of Refrigerants

5. COMPRESSORS. 10 Hours

5.1 Purpose of compressor.
5.2 Principle, Parts & Working of Different Types of compressors:
- 5.2.1 Reciprocating compressors.
- 5.2.2 Rotary compressors.
- 5.2.3 Centrifugal compressors.
- 5.2.4 Screw type compressor.
- 5.2.5 Scroll compressor

6. CONDNESERS 8 Hours

6.1 Purpose of condenser & receiver
6.2 Types of condensers, their construction and working.
6.3 Comparison between air-cooled and water-cooled condensers
6.4 Purpose of cooling tower and spray ponds.

7. REFRIGERANT CONTROL 8 Hours

7.1 Purpose of refrigerant control & its types.
7.2 Automatic expansion valve & its working principle.
7.3 Thermostatic expansion valve & its working principle.
7.4 Capillary tube refrigerant control.
7.5 Low side & High side pressure float valve and their working principle
7.6 Hand Expansion valve.

8. EVAPORATORS 6 Hours

8.1 Purpose of evaporator & its types
8.2 Flooded and dry expansion evaporators.
8.3 Frosting, non-frosting and defrosting evaporators.
8.4 Natural and forced convection evaporators.
8.5 Logarithmic Mean Temperature Difference (LMTD)

9. MOTOR CONTROLS 5 Hours

9.1 Purpose and types of motor controls.
9.2 Thermostatic motor controls.
- 9.2.1 Range and differential adjustment.

9.3 Low pressure motor control.
9.4 High pressure motor control.
9.5 Over-Load

9.6 Capacitors
9.7 Relay and its types.

RECOMMENDED BOOKS

1. Modern Refrigeration and Air Conditioning by Althouse.
2. Principles of Refrigeration by R. J. Dossat
3. ASHRAE Handbook- Fundamental & Equipment Volume.
4. Refrigeration and Airconditioning (A text book) by R.S. Khurmi and J.K. Gupta.
5. Manual prepared by National Institute of Science & Technology (NISTE), Ministry of Education, Government of Pakistan, Islamabad .

HVAC-113: PRINCIPLES OF REFRIGERATION

INSTRUCTIONAL OBJECTIVES:

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

1. **UNDERSTAND THE FUNDAMENTLS OF REFRIGERATION AND AIR CONDITIONING**
   - 1.1 Define energy & its types.
     - 1.1.1 Differentiate between K.E. and Potential energy.
   - 1.2 Define heat & its types, specific heat & its types, units of heat.
   - 1.3 Define temperature & its measurement, units and conversion
   - 1.4 Explain laws of thermodynamics.
   - 1.5 Explain the methods of heat transfer.
   - 1.6 Explain F.P.S.System, Metric system: and S.I.System and its conversion
   - 1.7 Define refrigeration
     - 1.7.1 Differentiate between refrigeration and air conditioning.
   - 1.8 Explain the types of refrigeration and its scope
   - 1.9 Problem Solutions

2. **UNDERSTAND THE SATURATED AND SUPERHEATED VAPOURS.**
   - 2.1 Define pressure, boiling point, melting point, force, work and their units
   - 2.2 Define saturated liquid, saturated vapor, sublimation & fusion, saturation temperature, vaporization, evaporation and condensation.
   - 2.3 Explain the effect of pressure on saturated temperature and critical temperature.
   - 2.4 Explain simple vapour compression cycle.
   - 2.5 Define condensing and evaporating pressure and temperature
     - 2.5.1 Define suction and discharge temperature of a refrigeration cycle.
   - 2.6 Define superheated vapor and sub-cooling

3. **UNDERSTAND THE IDEAL GAS LAWS.**
   - 3.1 Explain the effect of heat on solids, liquids and gases.
   - 3.2 Describe pressure-temperature-volume relationship of gases.
   - 3.3 Explain constant pressure process.
   - 3.4 Explain pressure volume relationship at constant temperature.
   - 3.5 Explain pressure temperature relationship at constant volume.
   - 3.6 Derive the general gas equation.
   - 3.7 Solve problems from given data.

4 UNDERSTAND THE ROLE OF REFRIGERANTS
   - 4.1 Define refrigerants
   - 4.2 Explain types of refrigerants
   - 4.3 Classify refrigerants according to application and safety.
   - 4.4 List and Define Group-I,II and III Refrigerants
   - 4.5 List the color code of refrigerant cylinders & their sizes and Describe refrigerant oils.
   - 4.6 State safety measure in handling refrigerants/compressed gases.

4.7 Explain the method of replacing different refrigerants.
4.8 Explain HCFC's Refrigerants.
4.9 Study the suction & discharge temperature and pressure of different refrigerants

5. UNDERSTAND THE WORKING PRINCIPLES AND USE OF COMPRESSORS IN REFRIGERATION & AIR CONDITIONING FIELD

5.1 State the purpose of compressor.
5.2 Explain the types of compressors , construction & working principles
- 5.2.1 Explain the types and working principle of reciprocating compressor.
- 5.2.2 Explain the types and working principal of rotary compressor.
- 5.2.3 Explain the types and working principle of screw type compressor.
- 5.2.4 Explain the types and working principle of centrifugal compressor.
- 5.2.5 Explain the construction and working principle of scroll compressor

6. UNDERSTAND THE TYPES AND APPLICATION OF CONDENSERS

6.1 Describe the purpose of condenser & receiver.
6.2 Explain the types of condensers & Explain the construction and working of condensers.
6.3 Comparison between air-cooled and water-cooled condenser.
6.4 Explain the working principles of cooling tower and spray ponds

7. UNDERSTAND THE CONCEPT AND WORKING PRINCIPLES OF REFRIGERANT CONTROLS

7.1 State the purpose of refrigerant controls (metering devices) & Name the types of refrigerant controls
7.2 Explain the working principle of automatic expansion value
7.3 Explain the working principle of the thermostatic expansion valves
7.4 Explain the working principles of capillary tube
7.5 Explain the working principles of low side & high side float valve
7.6 Explain the working of hand expansion valve

8. UNDERSTAND THE BASIC PRINCIPLES AND APPLICATION OF EVAPORATORS

8.1 Explain the purpose of evaporator & Describe the types of evaporators
8.2 Distinguish between flooded and dry expansion evaporators
8.3 Distinguish between frosting and non frosting types of evaporators.
8.4 Explain natural and forced convection evaporators.
8.5 Describe logarithmic mean temperature difference
8.6 Describe the types of evaporator regarding their construction, shape and temperature.

9. KNOW MOTOR CONTROLS

9.1 State the purpose & list the types of motor control
9.2 Explain thermostatic motor control
- 9.2.1 Define range and differential adjustment

9.3 Explain low pressure motor control
9.4 Define high pressure motor control
9.5 State overload

9.6 Define capacitor and its types
9.7 Explain relay and its types

HVAC-113: PRINCIPLES OF REFRIGERATION

LIST OF PRACTICALS 96 Hours

On completion of this course, the trainees will be able to;

1. Introduction and use of common refrigeration hand tools.
2. Introduction of refrigeration instruments and their uses.
3. Acquire skill in copper tube cutting, and flaring
4. Identify pipe fittings. Make flared tube connection. (Bending tube with spring bender & pulley bender single flare; double flare).
5. Make or repair a swaged tubing connection
6. Select fittings and make a complete tubing assembly.
7. Read gauges and operate gauge manifold.
8. Measure pressure in a refrigerating system with gauge manifold .
9. Operate service valves.
10. Overhaul and assemble a compressor.
11. Dismantle, Assemble and Test an external drive piston type compressor.
12. Gasket making Practice.
13. Dismantle, Clean, Assemble and Test a hermetic sealed reciprocating compressor.
14. Acquire skill in using Voltmeter, Ammeter and Ohmmeter (AVO meter) by;
    (a) Checking a capacitor
    (b) Checking a current relay
    (c) Checking a potential relay
    (d) Checking a thermal relay
    (e) Checking a solid state relay
    (f) Checking an overload protector.
15. Perform the compressor test for open, ground or shorts.
16. Test the fan motor for open, ground or short.
17. Check the compressor by direct method.
18. Identify the unmarked compressor terminals.
19. Run and perform Practical on a trainer to understand refrigeration cycle.
20. Replace a relay and overload protector.
21. Test and adjust a thermostat for cooling.
22. Connect a compressor with capacitor, relay and overload, and observe their working.
23. Measure some temperatures.

HVAC-121 SAFETY IN HVAC&R SYSTEMS

Total Contact Hours		**T**	**P**	**C**
Theory:	**32 Hours**	**1**	**0**	**1**

Pre-requisite:

Mental awareness.

AIMS:

1. Make the trainees habitual to apply safety Practices required at the workplaces in HVAC&R industry.

COURSE CONTENTS

1. GENERAL SAFETY APPLICATIONS 12 Hours

- 1.1 Personal safety
- 1.2 Equipment safety
  - 1.2.1 Electrical
  - 1.2.2 Mechanical
- 1.3 Using Refrigerant, other gases and accessories
  - 1.3.1 Exposure to refrigerants
  - 1.3.2 Refrigerant containers
  - 1.3.3 Other pressurized gas hazards (Nitrogen, Oxygen, Acetylene, & Liquid Petroleum)
- 1.4 Using Gas and oil heating equipment.
  - 1.4.1 Gas leaks
  - 1.4.2 Oil leaks
  - 1.4.3 Other gas and oil hearing precautions
- 1.5 Use of Tools
  - 1.5.1 Power tools
  - 1.5.2 Ladders and scaffolding
  - 1.5.3 Soldering and breezing equipment
  - 1.5.4 Rigging equipment
- 1.6 Weather precautions
  - 1.6.1 Hot weather precautions
  - 1.6.2 Cold weather precautions
- 1.7 Awareness
  - 1.7.1 Hazard and communication standard
  - 1.7.2 Confined spaces
  - 1.7.3 Hazardous waste management

2. SAFETY IN REFRIGERATION SYSTEMS 8 Hours

Safety Practices in;

2.1 Use of Refrigeration tools and materials
2.2 Compression system and compressors
2.3 Refrigerant controls
2.4 Refrigerants
2.5 Refrigerant recovery/recycling/reclaiming
2.6 Domestic refrigerators and freezers
2.7 Refrigeration commercial systems
2.8 Commercial system applications
2.9 Transport refrigeration

3. SAFETY IN ELECTRICAL COMPONENTS 2 Hours

Safety Practices in using;

3.1 Cardio-Pulmonary Resuscitation (CPR)
3.2 Electrical magnetic fundamentals
3.3 Electric motors
3.4 Electric circuits and controls

4. SAFETY IN AIR CONDITIONING SYSTEMS 8 Hours

Safety Practices in;

4.1 Basic heating and air conditioning systems
4.2 Commercial systems – Heat load and piping
4.3 Absorption systems
4.4 Air conditioning systems
4.5 Heating and humidification systems
4.6 Cooling and dehumidification systems
4.7 Air distribution and cleaning
4.8 Air conditioning and heating controls
4.9 Air conditioning (heat pumps) systems
4.10 Automotive air conditioning

5. SAFETY IN SERVICING AND INSTALLING HVAC&R SYSTEMS 2 Hours

Safety Practices in;

1.1 Servicing and installing small hermetic systems
1.2 Servicing and installing commercial systems
1.3 Servicing and troubleshooting

RECOMMENDED BOOK

1. Modern Refrigeration by Althouse
2. Teaching-Learning Resource Manual on Safety in HVAC&R system

HVAC-121 SAFETY IN HVAC&R SYSTEMS

INSTRUCTIONAL OBJECTIVES

On completion of this course, the students will be able to;

1. UNDERSTAND GENERAL SAFETY APPLICATIONS

- 1.1 Define personal safety
- 1.2 Explain equipment safety
  - 1.2.1 Electrical
  - 1.2.2 Mechanical
- 1.3 Describe refrigerant, other gases and accessories
  - 1.3.1 Exposure to refrigerants
  - 1.3.2 Refrigerant containers
  - 1.3.3 Other pressurized gas hazards (Nitrogen, Oxygen, Acetylene, & Liquid Petroleum)
- 1.4 Explain gas and oil heating equipment.
  - 1.4.1 Gas leaks
  - 1.4.2 Oil leaks
  - 1.4.3 Other gas and oil hearing precautions
- 1.5 Explain precautions in use of different tools
  - 1.5.1 Power tools
  - 1.5.2 Ladders and scaffolding
  - 1.5.3 Soldering and breezing equipment
  - 1.5.4 Rigging equipment
- 1.6 Describe weather precautions
  - 1.6.1 Hot weather precautions
  - 1.6.2 Cold weather precautions
- 1.7 Describe general safety awareness
  - 1.7.1 Hazard communication standard
  - 1.7.2 Confined spaces
  - 1.7.3 Hazardous waste management

2. UNDERSTAND SAFETY APPLICATIONS IN REFRIGERATION SYSTEMS

Explain safety Practices in;

- 2.1 Refrigeration tools and materials
- 2.2 Compression system and compressors
- 2.3 Refrigerant controls
- 2.4 Refrigerants
- 2.5 Refrigerant recovery/recycling/reclaiming
- 2.6 Domestic refrigerators and freezers
- 2.7 Refrigeration commercial systems
- 2.8 Commercial system applications
- 2.9 Transport refrigeration

3. UNDERSTAND SAFETY APPLICATIONS IN ELECTRICAL COMPONENTS

Explain safety Practices in;

- 3.1 Electrical magnetic fundamentals
- 3.2 Electric motors

3.3 Electric circuits and controls

4. UNDERSTAND SAFETY APPLICATIONS IN AIR CONDITIONING SYSTEMS

Explain safety Practices in;

4.1 Basic heating and air conditioning systems
4.2 Commercial systems – Heat load and piping
4.3 Absorption systems
4.4 Air conditioning systems
4.5 Heating and humidification systems
4.6 Cooling and dehumidification systems
4.7 Air distribution and cleaning
4.8 Air conditioning and heating controls
4.9 Air conditioning (heat pumps) systems
4.10 Automotive air conditioning

5. UNDERSTAND SAFETY APPLICATIONS IN SERVICING AND INSTALLING HVAC&R SYSTEMS

Explain safety Practices in;

5.1 Servicing and installing small hermetic systems
5.2 Servicing and installing commercial systems
5.3 Servicing and troubleshooting

HVAC-132: WORKSHOP PRACTICE-I

	T	P	C
Total Contact Hours	0	6	2

Practical: 192
a- Metal Shop
b- Machine/Welding Shop

Pre-requisite

General knowledge of some common hand tools.

Aims: i) Familiarization with the basic hand tools and their application in HVAC&R Trade.

ii) Understand the working and use of sheet metal workshop, machine shop and welding shop tools and equipment.

HVAC-132 WORKSHOP PRACTICE –I

LIST OF PRACTICALS

On completion of this course, the trainees will be able to;

A – METAL SHOP (Total: 96 Hours)

1. Measure parts using micrometers and exercise on micrometer/caliper.
2. Make a rivetted seam joint.
3. Make or repair soldered and brazed tubing connection.
4. Identify copper tubing/pipe fittings (Taps, Cocks, Valves etc.)
5. Select Copper tubing/pipe fittings and make a complete tubing assembly.
6. Cutting copper tubing with a tube cutter.
7. Make internal and external threads with taps and dies.
8. Select fittings and make a complete piping assembly of G.I. pipe fittings.
9. Laying out for a square duct.
10. Laying out for a round pipe.
11. Cutting metal with snips.
12. Making a grooved seam by hand
13. Making a single and double hemmed edge for seam joint.
14. Making a rectangular duct with a Pittsburgh Seam.
15. Making a duct with a double seam corner.
16. Making a two-way duct.
17. Making an Ice Tray.

B- MACHINESHOP/WELDING SHOP (Total: 96 Hours)

1. Make simple exercises using facing, centering, simple turning, step turning and knurling operations.

2. Make simple exercises applying taper turning, drilling and thread cutting skills.
3. Study of welding unit.
4. Study the safety in shop.
5. Flame making Practice and listing its types.
6. Making a Lap joint, Butt joint and Flange joints using 1/16″ mild steel sheet.
7. Tube soldering instructions.
8. Tube brazing instructions.
9. Welding and brazing procedures.
10. Soldering and brazing.
11. Making a copper tube brazing joint with brass filer rod using blow lamp.
12. Making an Arc welded pipe joint.
13. Welding a Hermetic Compressor dome.
14. Making a spot welded joint with 1/16″ mild steel sheets.
15. Repair refrigerator/deep freezer cabinet (sheet metal parts)

اسلامیات / مطالعہ پاکستان

مضمون (سال دوم)	GEN 211	ڈی	ٹی	سی
حصہ اول اسلامیات		1	0	1
حصہ دوم مطالعہ پاکستان		کل وقت: 20 گھنٹے		

موضوعات

1. سورۃ المومنون آیت تا گیارہ آیات کا مع ترجمہ
2. درس منتخب احادیث مع ترجمہ و تشریح
   - ☆ خیارکم من تعسیم القرآن وعلمه
   - ☆ لا ایمان لمن لا امانته له ولا دین لمن لا عهد له
   - ☆ وایاکم والظن فان الظن اکذب الحدیث
   - ☆ من احدث فی امرنا ہذا ما لیس منه فهو رد
   - ☆ من حمل علینا السلاح فلیس منا
   - ☆ انا و کافل الیتیم فی الجنته
   - ☆ لا ضرر ولا ضرار فی الاسلام
   - ☆ کلکم راع و کلکم راع و کلکم مسئول عن رعیته
3. سیرۃ طیبہ
   - ☆ مکی زندگی۔ دارارقم۔ ہجرت۔ اجرت
   - ☆ مدنی زندگی۔ مواخات۔ میثاق مدینہ۔ غزوات (اسباب و نتائج)
4. حضور ﷺ بحیثیت
   - ☆ خطبہ حجۃ الوداع
   - معلم کامل، سربراہ خاندان
5. اسلامی معاشرہ
   - نظام تعلیم اور اس کے مقاصد۔ عدل و انصاف۔ امر بالمعروف۔ نہی عن المنکر
   - جہاد۔ کسب حلال۔ مسجد (اہمیت و فضیلت)
   - ☆ اسلامی ریاست کی تعریف۔ اسلامی ریاست کی خصوصیات۔ اسلامی حکومت کے فرائض۔ اسلامی طرز حکومت

اسلامیات

تدریس مقاصد

عمومی مقاصد بطالبعلم یہ جان سکے کہ آیات قرآنی کی روشنی میں مومن کے اوصاف کیا ہیں

قرآن مجید منتخب آیات قرآنی

خصوصی مقاصد:

☆ قرآنی آیات کا ترجمہ بیان کر سکے

☆ قرآنی آیات کی تشریح کر سکے

☆ قرآنی آیات کی روشنی میں ایک مومن کے اوصاف بیان کر سکے

☆ قرآنی آیات میں بیان کردہ مومن کے اوصاف اپنے اندر پیدا کر سکے

احادیث نبویہ

☆ عمومی مقصد احادیث کی روشنی میں اسلامی اخلاقی اقدار (انفرادی و اجتماعی) سے آگاہ ہو سکے

خصوصی مقاصد:

☆ احادیث کا ترجمہ بیان کر سکے

☆ احادیث کی تشریح کر سکے

☆ احادیث کی روشنی میں اسلام کی اخلاقی اقدار کی وضاحت کر سکے

☆ ان احادیث کی دی گئی تعلیمات کے مطابق اپنی زندگی گزار سکے

سیرت طیبہ

☆ عمومی مقصد: حضور ﷺ کی سیرت طیبہ کے بارے میں جان سکے

خصوصی مقاصد:

☆ حضور ﷺ کی ابتدائی زندگی اختصار کے ساتھ بیان کر سکے

☆ حضور ﷺ کی ہجرت کا واقع بیان کر سکے

☆ حضور ﷺ کی مدنی زندگی اختصار سے بیان کر سکے

☆ حضور ﷺ کی بطور معلم خصوصیات بیان کر سکے

☆ حضور ﷺ کی بطور سربراہ خاندان بیان کر سکے

اسلامی معاشرہ

عمومی مقصد: اسلامی معاشرہ کی خصوصیات سے آگاہی حاصل کر سکے

خصوصی مقاصد:

☆ اسلامی معاشرہ کا معنی و مفہوم بیان کر سکے

☆ اسلامی معاشرہ کی امتیازی خصوصیات بیان کر سکے

☆ اسلامی معاشرہ میں عدل و احسان کی اہمیت بیان کر سکے

☆ تبلیغ کے لغوی معنی بیان کر سکے

☆ تبلیغ کی اہمیت و ضرورت بیان کر سکے

☆ جہاد کے لفظی و اصطلاحی معنی بیان کر سکے

☆ جہاد کی اہمیت بیان کر سکے

☆ جہاد اور قتل میں فرق بیان کر سکے

☆ جہاد کی مختلف اقسام بیان کر سکے

☆ لفظ مسجد کی تعریف کر سکے

مسجد کی سابقہ حیثیت کو بحال کرنے کے بارہ میں اقدامات کو بیان کر سکے

اسلامی ریاست

عمومی مقاصد۔ اسلامی ریاست کی خصوصیت بیان کر سکے

خصوصی مقاصد:

☆ ریاست کی تعریف بیان کر سکے

☆ اسلامی ریاست میں طرز حکومت سے آگاہی حاصل کر سکے

☆ اسلامی ریاست کی خصوصیات بیان کر سکے

☆ اسلامی ریاست کے اغراض و مقاصد بیان کر سکے

☆ اسلامی ریاست کے قیام کیلئے جدوجہد کر سکے

نصاب مطالعہ پاکستان

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کل وقت: 12 گھنٹے

سال دوم

حصہ دوم

موضوعات

- ☆ دو قومی نظریہ
- ☆ تحریک پاکستان
- ☆ انڈین کانگریس
- ☆ مسلم لیگ
- ☆ تقسیم بنگال
- ☆ میثاق لکھنؤ
- ☆ تحریک خلافت
- ☆ سندھ تحریک
- ☆ تجاویز رضی
- ☆ نہرو رپورٹ
- ☆ قائداعظم کے چودہ نکات
- ☆ خطبہ الہ آباد
- ☆ انتخابات 1936 اور انتخابی مہم
- ☆ قرارداد پاکستان

حصہ دوم

مطالعہ پاکستان

تدریس مقاصد

تحریک پاکستان

عمومی مقصد: قیام پاکستان کے اسباب و محرکات کو بیان کر سکے

خصوصی مقاصد:

- ☆ قومیت کے مفہوم کو بیان کر سکے
- ☆ دو قومی نظریہ کی تعریف و توضیح کر سکے
- ☆ دو قومی نظریہ اہمیت بیان کر سکے
- ☆ ہندوستانی مسلمانوں کی محرومیوں کو بیان کر سکے
- ☆ قومی تشخص کو بحال رکھنے کے لئے مسلمانان ہند کی مساعی بیان کر سکے
- ☆ آزادی ہند اور قیام پاکستان علامہ اقبال اور قائداعظم کی مساعی بیان کر سکے
- ☆ قیام پاکستان سے مستقبل اسلامی مملکت کے قیام کے لئے مسلم عوام کی کوششوں کو بیان کر سکے
- ☆ مسلم لیگ کے قیام پاکستان کے لئے جدوجہد بیان کر سکے

(غیر مسلم طلباء کے لئے)

نصاب اخلاقیات
سال دوم

ی	پی	ی
1	0	1

کل وقت: 20 گھنٹے

موضوعات

معاشرتی اقدار، خاندان، پڑوسی، قومی سطح، شہری سطح، صنعتی اداروں کی سطح، ضروریات، ورثہ

- ☆ حقوق و فرائض
- ☆ قوت برداشت
- ☆ قوت ارادی
- ☆ لگن و جذبہ
- ☆ وسیع النظری
- ☆ بے غرضی
- ☆ مثالی دوستی
- ☆ حفاظتی شعور
- ☆ پاس آزادی
- ☆ کامل اتفاق
- ☆ تغیرات کو قبول کرنا
- ☆ خود شناسی

نصاب اخلاقیات

سال دوم

تدریس مقاصد

عمومی مقاصد :

طالب علم: اخلاقیات کی اہمیت و ضرورت سے سمجھ بوجھ سکے اور بیان کر سکے

خصوصی مقاصد: طالب علم اس قابل ہو کہ

☆ موضوعات کا مطلب بیان کر سکے

☆ عملی زندگی سے مثالوں کی نشاندہی کر سکے

☆ اپنی شخصیت اور معاشرے پر موضوعات کے مطابق مثبت اثرات پیدا کرنے کے طریقے بیان کر سکے

☆ اعلیٰ اخلاقی اقدار میں سے

تحمل برداشت۔ قوت ارادی۔ لگن جذبہ۔ وسیع النظری۔ بے غرضی۔ انسانی دوستی حفاظتی۔ شعور۔ پسند آزادی۔

کامل اکائی اور خود شناسی کی اہمیت بیان کر سکے

☆ اخلاقیات سے متصف ہو کر قومی خدمت بہتر طور پر انجام دے سکے

Math-223: APPLIED MATHEMATICS-II

T	P	C
3	0	3

Total contact hours:

Theory 96
Practical 0

AIMS: The students will be able to:

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

COURSE CONTENT

1. FUNCTIONS AND LIMITS 6 Hours

- 1.1 Constant & Variable Quantities
- 1.2 Functions & their classification
- 1.3 The concept of Limit
- 1.4 Limit of a Function
- 1.5 Fundamental Theorems on Limit
- 1.6 Some important Limits
- 1.7 Problems

2. DIFFERENTIATION 6 Hours

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

3. DIFFERENTIATION OF ALGEBRAIC FUNCTIONS 9 Hours

- 3.1 Explicit Functions
- 3.2 Implicit Functions
- 3.3 Parametric forms
- 3.4 Problems

4. DIFFERENTIATION OF TRIGONOMETRIC FUNCTIONS 6 Hours

- 4.1 Differential Coefficient of Sin x, Cos x, Tan x from first principle.
- 4.2 Differential Coefficient of Cosec x, Sec x, Cot x

4.3 Differentiation of inverse Trigonometric functions.
4.4 Problems.

5. DIFFERENTIATIONS OF LOGARITHMIC & EXPONENTIAL FUNCTIONS 6 Hours

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

6. RATE OF CHANGE OF VARIABLES. 6 Hours

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

7. INTEGRATION 9 Hours

1.1 Concept
1.2 Fundamental Formulas
1.3 Important Rules
1.4 Problems

8. METHODS OF INTEGRATION. 9 Hours

8.1 Integration by substitution
8.2 Integration by parts
8.3 Problems

9. DIFINITE INTEGRALS 6 Hours

9.1 Properties
9.2 Application to area
9.3 Problems

10. DIFFERENTIAL EQUATIONS 6 Hours

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

11. PLANE ANALYTIC GEOMETRY & STRAIGHT LINE 6 Hours

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

12. EQUATIONS OF STRAIGHT LINE 6 Hours

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

13. EQUATIONS OF CIRCLE 6 Hours

- 13.1 Standard form of Equation
- 13.2 Central form of Equation
- 13.3 General form of Equation
- 13.4 Radius & Coordinates of the centre
- 13.5 Problems

14. STATISTICS 9 Hours

- 14.1 Concept of mean, median and mode
- 14.2 Standard deviation
- 14.3 Laws of probability
- 14.4 Problems

REFERENCE BOOKS

1. Thomas Finny – Calculus and Analytic Geometry.
2. Ghulam Yasin Minhas – Technical Mathematics Vol-II, Ilmi Kitab Khana, Lahore.
3. Prof. Riaz Ali Khan – Polytechnic Mathematic Series Vol I & II, Majeed Sons, Faisalabad.
4. Prof. Sana Ullah Bhatti – Calculus and Analytic Geometry, Punjab Text Book, Lahore.

Math-223: APPLIED MATHEMATICS

INSTRUCTIONAL OBJECTIVES

1. USE THE CONCEPT OF FUNCTIONS AND THEIR LIMITS IN SOLVING SIMPLE PROBLEMS

1.1 Define a function.
1.2 List all type of functions.
1.3 Explain the concept of limit and limit of a function.
1.4 Explain fundamental theorems on limits.
1.5 Derive some important limits.
1.6 Solve problems on limits.

2. UNDERSTAND THE CONCEPT OF DIFFERENTIAL COEFFICIENT

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

3. USE RULES OF DIFFERENTIATION TO SOLVE PROBLEMS OF ALGEBRAIC FUNCTIONS.

3.1 Differentiate ab-initio x^n and $(ax + b)^n$.
3.2 Derive product, quotient and chain rules.
3.3 Find derivatives of implicit functions and explicit functions.
3.4 Differentiate parameteric forms, functions w.r.t. another function and by rationalization.
3.5 Solve problems using these formulas.

4. USE RULES OF DIFFERENTIATION TO SOLVE PROBLEMS INVOLVING TRIGONOMETRIC FUNCTIONS.

4.1 Differentiate from first principle Sin x, Cos x, Tan x.
4.2 Derive formula Derivatives of Sec x, Cosec x , Cot x.
4.3 Find differential coefficients of inverse trigonometric functions
4.4 Solve problems based on these formulas.

5. USE RULES OF DIFFERENTIATION TO LOGARITHMIC AND EXPONENTIAL FUNCTIONS.

5.1 Derive formulas for differential coefficient of Logarithmic and exponential functions.
5.2 Solve problems using these formulas.

6. UNDERSTAND RATE OF CHANGE OF ONE VARIABLE WITH RESPECT TO ANOTHER.

6.1 Derive formula for velocity, acceleration and slope of a line.
6.2 Define an increasing and a decreasing function, maxima and minima values, point of inflexion.

6.3 Explain criteria for maxima and minima values of a function.
6.4 Solve problems involving rate of change of variables.

7. USE RULES OF INTEGRATION IN SOLVING RELEVANT PROBLEMS.

7.1 Explain the concept of integration.
7.2 State basic theorems of integration.
7.3 List some important rules of integration.
7.4 Derive fundamental formulas of integration.
7.5 Solve problems of integration based on these rules/formulas.

8. UNDERSTAND DIFFERENT METHODS OF INTEGRATION

8.1 List standard formulas of Integration.
8.2 Integrate a function by substitution method.
8.3 Find integrals of the method of integration by parts.
8.4 Solve problems using these methods.

9. UNDERSTAND METHODS OF SOLVING DEFINITE INTEGRALS.

9.1 Define definite integral.
9.2 List properties of definite integrals.
9.3 Find areas and work done under the curves using definite integrals.
9.4 Solve problems of definite integrals.

10. USE DIFFERENT METHODS OF INTEGRATION TO SOLVE DIFFERENTIAL EQUATIONS

10.1 Define a differential equation, its degree and order
10.2 Explain method of separation of variables to solve differential equation of first order and first degree.
10.3 Solve differential equations of first order and first degree.

11. UNDERSTAND THE CONCEPT OF PLANE ANALYTIC GEOMETRY.

11.1 Explain the rectangular coordinate system
11.2 Locate points in different quadrants.
11.3 Derive distance formula.
11.4 Prove ratio formulas.
11.5 Derive Slope Formula.
11.6 Solve problem using these formulas.

12. USE EQUATIONS OF STRAIGHT LINE IN SOLVING PROBLEMS.

12.1 Define a straight line.
12.2 Write general form of equation of a straight line.
12.3 Derive slope intercept and intercept forms of equations of a straight line.
12.4 Derive expression for angle between two straight lines.
12.5 Derive conditions of perpendicularity and parallelism of two straight lines.
12.6 Solve problems involving these equations/formulas.

13. SOLVE TECHNOLOGICAL PROBLEMS USING EQUATIONS OF CIRCLE.

13.1 Define a circle.
13.2 Describe standard, central and general forms of the equation of a circle.
13.3 Convert general form to the central form of equation of a circle.

13.4 Derive formula for the radius and the coordinates of the center of a circle from the general form.
13.5 Derive equation of the circle passing through three given points.
13.6 Solve problems involving these equations.

14. UNDERSTAND THE BASIC CONCEPT OF STATISTICS.

14.1 Define mean, median and mode
14.2 Explain standard deviation
14.3 State laws of probability
14.4 Calculate the above mentioned quantities using the proper formula.

MGM-242: BUSINESS MANAGEMENT AND ACCOUNTING

T	P	C
2	0	2

Total contact hours:

Theory 64
Practical 0

Pre-Requisite:

1. General understanding of management and accounts.
2. Ability to go through the study material.
3. Active mind.
4. Motivation.

AIMS: The course has been designed to enable the students:

1. To understand the policies and programmes of management and proper execution thereof in industrial and commercial set up.
2. To acquaint the students to handle the accounts.
3. To solve problems of business management.

COURSE CONTENTS

BUSINESS MANAGEMENT

1. ECONOMICS 3 Hours

1.1 Definition: Adam Smith, Alfred Marshal, Professor Robbins.
1.2 Nature and scope.
1.3 Importance for foreman and technicians.
1.4 Basic concepts in economics (Utility, Marginal, Income, Wealth, Saving, Investment).

2. DEMAND AND SUPPLY 3 Hours

2.1 Definition.
2.2 Law of Demand.
2.3 Definition of Supply.
2.4 Law of Supply.

3. FACTORS OF PRODUCTION 3 Hours

3.1 Land.
3.2 Labour.
3.3 Capital.
3.4 Organization.

4. BUSINESS ORGANIZATION 3 Hours

4.1 Sole proprietorship.
4.2 Partnership.
4.3 Joint Stock Company.

5. SCALE OF PRODUCTION 3 Hours

5.1 Meaning and its determination.
5.2 Large scale production.
5.3 Small scale production.

6. LAWS OF RETURN 3 Hours

6.1 Law of increasing return.
6.2 Law of constant return.
6.3 Law of diminishing return.

7. ECONOMICS SYSTEMS 3 Hours

7.1 Free economic system.
7.2 Centrally controlled economy.
7.3 Mixed economic system.

8. MONEY 2 Hours

8.1 Barter system and its inconveniences.
8.2 Definition of money and its functions.

9. BANK 2 Hours

9.1 Definition.
9.2 Functions of a commercial bank.
9.3 Central bank and its functions.

10. CHEQUE 2 Hours

10.1 Definition.
10.2 Characteristics and kinds of cheques.
10.3 Dishonour of cheque.

11. FINANCIAL INSTITUTION 3 Hours

11.1 IMF.
11.2 IDBP.
11.3 PIDC.

12. MANAGEMENT 3 Hours

12.1 Meaning.
12.2 Functions of management.
12.3 Problems of business management.

ACCOUNTING

1. BOOK KEEPING 3 Hours

1.1 Definition.
1.2 Objects.
1.3 Double entry system.
1.4 Important accounting terms used usually.

2. ACCOUNTING 3 Hours

2.1 Definition.
2.2 Branches.
2.3 Functions.
2.4 Parties interested in accounting information.

3. NATURE OF ACCOUNTS AND RULES OF DEBIT AND CREDIT 2 Hours

3.1 Classification of accounts.
3.2 Rules of debit and credit.

4. JOURNAL 2 Hours

4.1 Definition and characteristics.
4.2 Entry.
4.3 Rules for journalizing.

5. LEDGER 2 Hours

5.1 Definition and features.
5.2 Methods of posting.

6. TRIAL BALANCE 3 Hours

6.1 Definition.
6.2 Objectives.
6.3 How to prepare it.

7. BANKING TRANSACTIONS 2 Hours

7.1 Introduction.
7.2 Methods of recording such transactions.

8. SUB-DIVISION OF JOURNAL-I 2 Hours

8.1 Cash Book and its kinds. (Single, double and three column cash book).
8.2 The petty cash book and its preparation.

9. SUB-DIVISION OF JOURNAL-II 3 Hours

9.1 Purchase and purchase return book.
9.2 Sales and sales return book.
9.3 Bills receivable book.
9.4 Bills payable book.

10. DEPRECIATION 2 Hours

10.1 Definition and necessity for charging depreciation.
10.2 Fixed installment method.
10.3 Diminishing balance method.

11. CAPITAL AND REVENUE 3 Hours

11.1 Capital and revenue expenditure.
11.2 Deferred revenue expenditure.

11.3 Capital and revenue payment.
11.4 Capital and revenue profits.
11.5 Capital and revenue loss.

12. RECTIFICATION OF ERRORS 2 Hours

12.1 Book keeping and trial balance errors.
12.2 Correcting the errors.

13. FINAL ACCOUNTS 2 Hours

13.1 The concept of final account.
13.2 Preparation of trading profit and loss account.
13.3 Preparation of balance sheet.

BOOKS RECOMMENDED

1. Business Organization, Nisar-ud-Din, Aziz Publishers, Lahore.
2. An Introduction to Modern Economics, S. M. Akhtar, United Publishers Ltd., Lahore.
3. Nizamat-e-Sanaat Aur Insani Rawabat by Ghulam Hussain (Ilmi Kitab Khana, Urdu Bazar, Lahore).
4. The Process of Management by Andrew R. Megill William M. Newman.
5. Factory and Production Management by K.G. Lockyer.
6. Financial Accounting, Meigs and Meigs, McGraw Hill Book Co.
7. Principle of Accounting, M. A. Ghani, H. Y. Printer, Lahore.

MGM-242: BUSINESS MANAGEMENT AND ACCOUNTING

INSTRUCTIONAL OBJECTIVES

(BUSINESS MANAGEMENT)

1. UNDERSTAND THE IMPORTANCE OF ECONOMICS

1.1 State definition of economics given by Adam Smith, Alfard Marshall and Professor Robins.
1.2 Explain nature and scope of economics.
1.3 Describe importance of study economics for technicians.
1.4 Define basic terms, utility, income, wealth, saving, investment and value.
1.5 Explain the basic terms with examples.

2. UNDERSTAND LAW OF DEMAND AND LAW OF SUPPLY.

2.1 Define demand
2.2 Explain law of demand with the help of schedule and diagram.
2.3 State assumptions and limitation of law of demand.
2.4 Define supply
2.5 Explain law of supply with the help of schedule and diagram
2.6 State assumptions and limitation of law of supply.

3. UNDERSTAND FOUR FACTORS OF PRODUCTION.

3.1 Define the four factors of production
3.2 Explain labour and its features.
3.3 Describe capital and its peculiarities.

4. UNDERSTAND FORMS OF ORGANIZATION

4.1 Describe sole proprietorship, its merits and demerits.
4.2 Explain partnership, its advantages and disadvantages.
4.3 Describe join stock company, its merits and demerits.
4.4 Distinguish between public limited company and private limited company.

5. UNDERSTAND SCALE OF PRODUCTION

5.1 Explain scale of production and its determination.
5.2 Describe large scale production and its merits.
5.3 Explain small scale of production, its advantages and disadvantages.

6. UNDERSTAND LAW OF RETURN

6.1 Explain law of increasing return
6.2 Explain law of constant return
6.3 Explain law of diminishing return]

7. UNDERSTAND DIFFERENT ECONOMIC SYSTEMS

7.1 Describe free economic system and its characteristics.
7.2 Explain centrally planned economic system, its merits and demerits.

7.3 State mixed economic system and its features.

8. UNDERSTAND MONEY

8.1 Explain barter system and its inconveniences
8.2 Define money.
8.3 Explain the factors of money.

9. UNDERSTAND BANK AND ITS FUNCTIONS

9.1 Define bank.
9.2 Describe commercial bank and its functions.
9.3 State central bank and its functions.

10. UNDERSTAND CHEQUE AND DISHONOR OF CHEQUE

10.1 Define cheque.
10.2 Enlist the characteristics of cheque.
10.3 Identify the kinds of cheque.
10.4 Describe the causes of dishonor of a cheque.

11. UNDERSTAND FINANCIAL INSTITUTIONS.

11.1 Explain IMF and its objectives.
11.2 Explain organisational setup and objectives of IDBP.
11.3 Explain organisational setup and objectives PIDC.

12. UNDERSTAND MANAGEMENT

12.1 Define management
12.2 Describe functions of management
12.3 Explain the problems of management

(ACCOUNTING)

1. UNDERSTAND THE BASIC CONCEPTS OF BOOK KEEPING

1.1 State Book Keeping.
1.2 Identify the uses of Book Keeping.
1.3 Explain double entry system of Book Keeping.
1.4 Describe basic Accounting terms.

2. UNDERSTAND ACCOUNTING AND ITS FUNCTIONS

2.1 Define accounting.
2.2 Explain functions of accounting.
2.3 Describe parties interested in accounting information.

3. APPLY RULES OF DEBIT AND CREDIT

3.1 Describe different classes of accounts.
3.2 Explain rule of debit and credit.
3.3 Apply rule of debit and credit.

4. UNDERSTAND JOURNAL

4.1 Define journal and its features.
4.2 Explain entry.
4.3 Show entry in journal.
4.4 Describe rules of journalizing.
4.5 Apply rules of journalizing.

5. APPLY METHOD OF POSTING

5.1 Define ledger.
5.2 Describe characteristics of ledger.
5.3 Explain method of posting.
5.4 Apply method of posting.

6. PREPARE TRIAL BALANCE

6.1 State trial balance.
6.2 List objectives of trial balance.
6.3 Prepare trial balance.

7. RECORDING OF BANKING TRANSACTIONS

7.1 Describe banking transactions.
7.2 Pass entries of bank transactions.

8. PREPARE CASH BOOK

8.1 Define cash book.
8.2 Prepare single, double and three column cash book.
8.3 Define petty cash book.
8.4 Prepare petty cash book.

9. PREPARE OTHER SUBSIDIARY BOOK

9.1 Prepare purchases and purchases return book.
9.2 Prepare sales and sales return book.
9.3 Prepare bills receivable book.
9.4 Prepare bills payable book.

10. APPLY DEPRECIATION METHODS

10.1 Define depreciation.
10.2 State necessity for charging depreciation.
10.3 Apply fixed installment method.
10.4 Apply diminishing balance method.

11. DISTINGUISH CAPITAL AND REVENUE EXPENDITURE: CAPITAL AND REVENUE RECEIPTS

11.1 Differentiate between capital and revenue expenditure.
11.2 Differentiate between capital and revenue receipts.

12. RECTIFY THE ACCOUNTING ERRORS

12.1 Identify the errors in books of accounts.
12.2 Correct the errors found in books of accounts.

13. PREPARE ANNUAL ACCOUNTS

13.1 Describe final accounts.
13.2 Prepare trading accounts.
13.3 Prepare profit and loss account.
13.4 Prepare balance sheet.

Phy-212: APPLIED PHYSICS / APPLIED MECHANICS

T	P	C
1	3	2

Total contact hours:

Theory	32
Practical	96

AIMS:

1. Apply the concepts of Applied Physics to understand Mechanics.
2. Apply laws and principles of Mechanics in solving technological problems.
3. Use the knowledge of App. Mechanics in learning advance technical courses.
4. Demonstrate efficient skill of Practical work in Mechanics Lab.

COURSE CONTENTS

1. MEASUREMENTS 2 Hours

- 1.1 Review: Dimensional formula of Equations of Motion
- 1.2 Review: Systems of measurement, S.I. Units, conversion
- 1.3 Significant Figures
- 1.4 Degree of accuracy

2. EQUILIBRIUM OF CON-CURRENT FORCES 3 Hours

- 2.1 Concurrent forces
- 2.2 Addition and Resolution of Vectors
- 2.3 Toggle Joint, Hanging Chains
- 2.4 Roof Trusses, Cranes.
- 2.5 Framed structures

3. MOMENTS AND COUPLES 2 Hours

- 3.1 Principle of Moments – Review
- 3.2 Levers
- 3.3 Safety valve
- 3.4 Steel yard
- 3.5 Parallel forces, couple
- 3.6 Torque

4. EQUILIBRIUM OF NON CONCURRENT FORCES 3 Hours

- 4.1 Non-concurrent forces
- 4.2 Free body diagram
- 4.3 Varignon’s theorem
- 4.4 Conditions of total equilibrium
- 4.5 Ladders

5. MOMENT OF INERTIA 3 Hours

- 1.1 Review: Rotational Inertia
- 1.2 Moment of Inertia, Theorems

1.3 Moment of Inertia of symmetrical bodies
1.4 M.I. of Fly wheel with applications
1.5 Energy stored by Fly wheel

6. FRICTION 2 Hours

6.1 Review: Laws of friction
6.2 Motion of body along an inclined plane (up & down)
6.3 Rolling friction & Ball Bearings
6.4 Fluid Friction, Stoke's Law

7. WORK, ENERGY AND POWER 3 Hours

7.1 Work-Energy relationship
7.2 Work done by variable force
7.3 Power
7.4 I.H.P., B.H.P. and Efficiency
7.5 Dynamometer

8. TRANSMISSION OF POWER 3 Hours

8.1 Belts, Ropes.
8.2 Chains
8.3 Gears
8.4 Clutches, functions and types with application

9. MACHINES 3 Hours

9.1 Efficiency of machines
9.2 Inclined plane – Review
9.3 Reversibility of machines
9.4 Single purchase crab
9.5 Double purchase crab
9.6 Worm and worm wheel
9.7 Differential Screw Jack
9.8 Differential Pulley, Wheel and Axle

10. VIBRATORY MOTION 2 Hours

10.1 S.H.M. – Review
10.2 Pendulums
10.3 Speed Governors
10.4 Helical spring
10.5 Cams
10.6 Quick return motion

11. ELASTICITY 3 Hours

11.1 Three Modulii of Elasticity
11.2 Loaded Beams, Types of Beam & Loads
11.3 Bending Stress
11.4 S.F. & B.M. diagram
11.5 Torsion and Torsional Stresses

12. SIMPLE MECHANISM 1 Hour

12.1 Introduction
12.2 Kinematic link or Element
12.3 Kinematic pair and types
12.4 Kinematic chains and types

13. VELOCITY IN MECHANISM 2 Hours

13.1 Introduction
13.2 Instantaneous centre
13.3 Instantaneous velocity
13.4 Velocity of a link by instantaneous centre method
13.5 Relative velocity of two bodies in the straight line
13.6 Velocity of a link by relative velocity method

Phys-212: **APPLIED PHYSICS / APPLIED MECHANICS**

INSTRUCTIONAL OBJECTIVES

1. USE THE CONCEPTS OF MEASUREMENT IN PRACTICAL SITUATIONS/PROBLEMS

- 1.1 Explain Dimensional formula
- 1.2 Explain systems of measurement
- 1.3 Use concept of significant figures and degree of accuracy to solve problems

2. USE THE CONCEPT OF ADDITION AND RESOLUTION OF VECTORS TO PROBLEMS ON EQUILIBRIUM INVOLVING CONCURRENT FORCES

- 2.1 Describe concurrent forces
- 2.2 Explain resolution of vectors
- 2.3 Use the analytical method of addition of vectors for solving problems.
- 2.4 Use the graphical method of addition of solving problems.
- 2.5 Solve problems on forces with emphasis on roof trusses, cranes simple frames and framed structures.

3. USE THE PRINCIPLE OF MOMENTS AND CONCEPT OF COUPLE TO SOLVE PROBLEMS

- 3.1 Describe the principle of moments.
- 3.2 Use the principle of moments to solve problems on compound levers, safety valve, steel-yard.
- 3.3 Describe couple and torque.
- 3.4 Use the concept to solve problems on torque.

4. USE THE LAWS OF TOTAL EQUILIBRIUM OF FORCES TO SOLVE PROBLEMS INVOLVING FORCES IN EQUILIBRIUM

- 4.1 Distinguish between concurrent and non-concurrent forces.
- 4.2 Prepare a free body diagram of an object or a structure
- 4.3 Explain Varignon's theorem.
- 4.4 Explain the second condition of equilibrium
- 4.5 Use laws of total equilibrium to solve problems on forces involving framed structure and ladders.

5. USE CONCEPTS OF MOMENT OF INERTIA TO PRACTICAL SITUATIONS AND PROBLEMS

- 5.1 Explain moment of inertia
- 5.2 Explain the theorems of parallel and perpendicular axis
- 5.3 Describe the M.I. of regular bodies
- 5.4 Explain M.I. of fly wheel
- 5.5 Explain energy stored by fly wheel
- 5.6 Use these concepts to solve simple problems.

6. UNDERSTAND THE CONCEPTS AND LAWS OF SOLID AND FLUID FRICTION

6.1 Define coefficient of friction between a body placed on an inclined plane and the surface.
6.2 Explain motion of a body placed on an inclined plane
6.3 Calculate the force needed to move a body up and down an inclined plane.
6.4 Explain rolling friction and use of ball bearings
6.5 Describe fluid friction and Stoke's law.

7. UNDERSTAND WORK, ENERGY AND POWER

7.1 Derive work-energy relationship
7.2 Use formulae for work done by a variable force to solve problems.
7.3 Explain Power, I.H.P., B.H.P. and efficiency.
7.4 Describe dynamomenters.
7.5 Use the concepts to solve problems on power and work energy.

8. UNDERSTAND TRANSMISSION OF POWER THROUGH ROPES AND BELTS

8.1 Describe the need for transmission of power.
8.2 Describe methods of transmission of power.
8.3 Describe transmission of power through ropes and belts.
8.4 Write formula for power transmitted through ropes and belts.
8.5 Describe transmission of power through friction gears and write formula.
8.6 Describe transmission of power through chains and toothed wheels/gears.
8.7 Use the formulae to solve/problems on transmission of power.
8.8 Describe types and function of clutches with applications.

9. USE THE CONCEPTS OF MACHINES TO PRACTICAL SITUATIONS

9.1 Explain theoretical, actual mechanical advantage and efficiency of simple machines.
9.2 Use the concept to calculate efficiency of an inclined plane
9.3 Describe reversibility of machines.
9.4 Calculate the efficiency of:
  (i) Single purchase crab.
  (ii) Double purchase crab.
  (iii) Worm and worm wheel.
  (iv) Differential screw jack, Diff. pulley, wheel and axle.
9.5 Use the formulae to solve the problems involving efficiency, M.A. of the above machines.

10. USE THE CONCEPTS OF VIBRATORY MOTION TO PRACTICAL SITUATIONS

10.1 Define vibratory motion giving examples.
10.2 Describe circular motion and its projection on diameter of the circular path.
10.3 Relate rotatory motion to simple vibratory motion.
10.4 State examples of conversion of rotatory motion to vibratory motion and vice versa.
10.5 Describe speed governors, cams, quick return motion.
10.6 Derive formulae for position, velocity and acceleration of a body executing S.H.M.
10.7 Use the concept of S.H.M. to helical springs.

10.8 Use the concept of S.H.M. to solve problems on pendulum.

11. UNDERSTAND BENDING MOMENTS AND SHEARING FORCES

11.1 Define three types of stresses and modulii of elasticity.
11.2 Describe types of beams and loads.
11.3 Explain shearing force and bending moment.
11.4 Use these concepts to calculate S.F. and B.M. in a given Practical situation for point loads, uniformly distributed load.
11.5 Prepare S.F. and B.M. diagram for loaded cantilever and simply supported beams.
11.6 Describe torsion and torsional stresses giving formula.

12. UNDERSTAND SIMPLE MECHANISMS

12.1 Define simple mechanisms.
12.2 Define kinematics.
12.3 Explain kinematic link or element.
12.4 Explain kinematic chains.
12.5 Distinguish between types of kinematic chains.

13. UNDERSTAND THE METHOD OF FINDING VELOCITY IN MECHANISMS.

13.1 Explains relative velocity.
13.2 Explain instantaneous center.
13.3 Explain instantaneous velocity.
13.4 Explain the method of finding velocity of a link by:
(i) Relative velocity method.
(ii) Instantaneous center method.

Phys-212: APPLIED PHYSICS / APPLIED MECHANICS

LIST OF EXPERIMENTS

On completion of this course, the trainees will be able to;

1. Find the weight of the given body using Law of Polygon of forces.
2. Find unknown forces in a given set of concurrent forces in equilibrium using Grave-sands apparatus
3. Set a jib crane and analyse forces in its members
4. Set a Derrick Crane and analyse forces in its members
5. Study forces shared by each member of a Toggle Joint.
6. Set a Roof Truss and find forces in its members.
7. Verify Principle of Moments in a compound lever.
8. Calibrate a steelyard.
9. Find the Reactions at the ends of a loaded beam.
10. Use Reaction of Beams apparatus to study resultant of parallel forces.
11. Find the Moment of Inertia of a Flywheel.
12. Find the angle of reaction of a wooden block placed on an inclined plane.
13. Find the B.H.P. of a motor.
14. Study the transmission of Power through friction gears.
15. Study the transmission of Power through belts.
16. Study the transmission of Power through toothed wheels
17. Study the function of clutches.
18. Find M.A. and Efficiency of worm and worm wheel.
19. Find M.A. and efficiency of differential wheel and axle.
20. Find the efficiency of a screw.
21. Find the efficiency of a differential pulley
22. Study conversion of rotatory motion to S.H.M. using S.H.M. Model/Apparatus.
23. Study conversation of rotatory motion to vibratory motion of the piston in a cylinder.
24. Study the reciprocating motion.
25. Study the working of cams.
26. Study the quick return motion.
27. Compare the Elastic constants of the given wires.
28. Verify Hooke's Law using Helical Spring.
29. Find the coefficient of Rigidity of a wire using Maxewell's needle.
30. Find the coefficient of Rigidity of a round bar using torsion apparatus.
31. Find the coefficient of Rigidity of a rectangular bar using Deflection of Beam apparatus.
32. Determine S.F. and B.M. in a loaded canti-lever (Point Loads).
33. Determine S.F. and B.M. in a simply supported Beam (Point Loads).
34. Determine S.F. and B.M. in a simply supported Beam (Point loads and uniformly distributed load).
35. Determine S.F. and B.M. in a simply supported Beam (Point loads and uniformly distributed).
36. Study working and function of link mechanism of different types.

BOOKS RECOMMENDED:

1. Applied Mechanics by R.S. Khurmi.
2. Applied Mechanics by A.P.S. Sahihney & Prakash D. Manikpyny.
3. Applied Mechanics by Inchley and Morley.
4. Theories of Machines by R.S. Khurmi and J.K. Gupta.
5. Applied Mechanics by Junarker.
6. Engineering Science Vol-I by Brown and Bryant
7. Practical Physics by Mehboob Ilahi Malik & Ikram-ul-Haq.
8. Experimental Physics Note Book by M. Aslam Khan & M. Akram Sandhu
9. Experimental Mechanics (Urdu Process) by M. Akram Sandhu.

HVAC-214: PRINCIPLES OF AIR-CONDITIONING

T	P	C
3	3	4

Total contact hours

Theory 96 hours
Practical 96 hours

Prerequisites.

1. Knowledge of fundamentals of science.
2. Knowledge of Principles of Refrigeration.

Aims: 1. At the end of the course the students will be able to understand principles of air-conditioning, properties of air, psychrometric charts, psychrometric calculation, comfort and effective temperature, air-conditioning methods, state and quantity of supply air, humidification and dehumidification of air.

2. Understand psychrometric and perform heat load calculation, and calculations for the conditioned air supply.

1. INTRODUCTION TO AIR CONDITIONING. 4 Hours

1.1 Introduction of comfort air conditioning.
1.2 Introduction to equipment used in air conditioning systems
1.3 Classification of Air conditioning systems.
1.4 Scope of Air conditioning in various industries

2. REVIEW OF HEAT ENERGY 4 Hours

2.1 Sensible heat.
2.2 Latent heat.
2.3 Total heat
2.4 Specific heat & its Types.
2.5 Problem solving

3. PSYCHROMETRIC PROPERTIES OF AIR 16 Hours

3.1 Psychometric terms
3.2 The composition of air
3.3 Water vapor in the air (moist air)
3.4 Use of steam table
3.5 The laws of gases
3.6 The general gas law
3.7 Dalton's law of partial pressure.
3.8 Dry bulb temperature (DBT).
3.9 Wet bulb temperature (WBT)
3.10 Dew point temperature (DPT)
3.11 Sling psychrometer
3.12 Specific humidity (Sp.H)
3.13 Relative humidity (RH) and percentage humidity.
3.14 Specific volume (Sp.Vol)

3.15 Enthalpy (h)
3.16 Problem Solving

4. AIR AND HUMAN COMFORT. 8 Hours

4.1 Air temperature and human health.
4.2 Body temperature.
4.3 Ventilation requirement and air movement for comfort.
4.4 COMFORT zone
4.5 Effective temperature.
4.6 Factor of A.C. design.

5. ENERGY CONSERVATION 10 Hours

5.1 The Concept of Energy Conservation
5.2 Kinds of Energy To be conserved
5.3 Sources of energy & their utilization
5.4 Standards and codes.
5.5 Analysis (measuring) energy conservation.
5.6 Principles of Heat Recovery
5.7 Energy conservation by degree day method.
5.8 Methods of energy conservation.
5.9 Use of **Software** in HVAC&R system.
5.10 Applications of energy conservation in HVAC&R.
5.11 Problem solving.

6. PSYCHROMETRIC CHARTS 10 Hours

6.1 Psychrometric chart.
6.2 Dry bulb temperature lines.
6.3 Wet bulb temperature lines.
6.4 Dew point temperature line.
6.5 Specific humidity lines.
6.6 Relative humidity lines.
6.7 Specific volume lines.
6.8 Enthalpy lines
6.9 Entropy Lines
6.10 Saturation lines.
6.11 Problem solving.

7. PSYCHROMETRIC PROCESSES. 12 Hours

7.1 Cooling.
7.2 Heating.
7.3 Humidification
7.4 Dehumidification
7.5 Cooling and humidification
7.6 Cooling and dehumidification.
7.7 Heating and humidification.
7.8 Heating and dehumidification.
7.9 Air mixing process.
7.10 Sensible heat ratio (SHR)
7.12 By pass factor (BF)

7.12 Apparatus dew point (ADP)
7.13 Standard design conditions. (SRDC)

8. CALCULATION ON PSYCHROMETRIC PROCESSES. 16 Hours

Solution of problems on topics from 8.1 to 8.13

9. CALCULATION FOR THE CONDITIONED AIR SUPPLY. 16 Hours

9.1 Heating or cooling with air
9.2 Moisture calculations.
9.3 Sensible heat, Latent heat and Total heat calculations.
9.4 Dry bulb temperature and humidity.
9.5 By passed return air.
9.6 By passed outdoor air.
9.7 By passed mixed air.
9.8 The air conditioning cycle.
9.9 Capacity of refrigerating plant.
9.10 Problem solving

REFERENCE BOOKS

1. ASHRAE Fundamentals 2005
2. Trane Air Conditioning manual.
3. Principles of Refrigeration by R. J. Dossat
4. Carrier system design Manual.
5. Air conditioning and Refrigeration by Norman Harries.
6. Modern Refrigeration and Air conditioning by Althouse.
7. Principles of Air conditioning by Lang.
8. Basic Air Conditioning by Schmaltzier, Gerald & Eveling.
9. Refrigeration and Air Conditioning (A Text Book) by R.S. Khurmi, and J.K. Gupta.
10. Manual prepared by National Institute of Science & Technology (NISTE), Ministry of Education, Government of Pakistan, Islamabad.

HVAC-214: PRINCIPLES OF AIR-CONDITIONING

INSTRUCTIONAL OBJECTIVES:

On completion of this course, the student will be able to:

1. UNDERSTAND THE IMPORTANCE OF AIR-CONDITIONING.

1.1 Define comfort air conditioning
1.2 Name the equipment used in an air conditioning system.
1.3 Enlist the types of air-conditioning.
1.4 Explain the scope of air conditioning in industries.

2. UNDERSTAND THE HEAT ENERGY AND ITS TYPES.

2.2 Define sensible heat
2.3 Define latent heat
2.4 Define total heat.
2.5 Explain the specific heat and its types.
2.5 Solve problems on sensible heat and latent heat.

3. UNDERSTAND THE PRINCIPLES OF PSYCHROMETRY

5.12 Explain the pyschrometric terms and water vapour in the air (moist air).
5.13 Use of steam tables.
5.14 State laws of gases and general gas law.
5.15 Define Dalton's law of partial pressure.
5.16 Define, DB, WB, DP temperature with units.
5.17 Explain the sling psychrometer and its use.
5.18 Define Sp.H, RH, Sp.vol and enthalpy with units.
5.19 Solve relevant problems.

4. KNOW THE PRINCIPLES INVOLVED IN THE AIR AND HUMAN COMFORT.

4.1 Discuss the effect of air temperature on human health.
4.2 State the ventilation requirement and air movement for human comfort.
4.3 Explain the factors affecting the body temperature.
4.4 Describe effective temperature and its importance.
4.5 Describe comfort zone.
4.6 Trace comfort health index and comfort zone.
4.7 Trace the comfort chart and effective temperature.
4.8 State factors of A/C design.

5. UNDERSTAND ENERGY CONSERVATION

4.1 Define energy conservation.
4.2 Name the kinds of energy which can be conserved.
4.3 Describe the sources of energy & their utilization.
4.4 Explain the analysis (measuring) of energy conservation in different processes.
4.5 Describe the energy conservation by degree day method.
4.6 State the methods of energy conservation.

4.7 Explain the use of software in HVAC&R systems.
4.8 Explain the methods of energy conservation applicable to HVAC&R
4.9 Solve problems.

6. UNDERSTAND THE ROLE OF PSYCHROMETRIC CHART.

6.1 Trace the lines of DB, WB, DPT, Specific humidity, RH, Sp. volume, saturation lines on psychrometric chart.
6.2 Explain the form of lines and their units.
6.3 Solve problems.

7 UNDERSTAND THE PROCESS OR PROCESSES INVOLVED IN PSYCHROMETRIC CHART

7.1 Trace cooling and heating process on psychrometric chart.
7.2 Trace humidification and dehumidification processes.
7.3 Explain the cooling and humidification cooling and dehumidification processes.
7.4 Explain heating and humidification process.
7.5 Explain the air-mixing process and trace on psychrometric chart.
7.6 Describe sensible heat ratio and by pass factor.
7.7 Explain apparatus dew point and standard design conditions.

8. UNDERSTAND THE PSYCHROMETRIC PROCESSES CALCULATIONS

8.1 Solve problems on topics 8.1 to 8.13 with the help of psychrometric charts.

9. UNDERSTAND THE CONDITIONED AIR SUPPLY CALCULATIONS.

9.1 Solve problems relating to heating of air, cooling of air and moisture contents.
9.2 Calculate latent heat, quantity of air and condition of the air supply.
9.3 Calculate the quantity of bypassed return air, bypassed out door air and sensible heat ratio.
9.4 Illustrate the air conditioning cycle with the help of psychrometric chart.
9.5 Explain the capacity of a refrigerating plant.

HVAC-214**:** **PRINCIPLE OF AIR-CONDITIONING**

LIST OF PRACTICALS **(Total 96 Hours)**

On completion of this course, the trainees will be able to;

A. PSYCHROMETICS 18 Hours

1. Using a sling psychrometer to determine wet and dry bulb temperatures.
2. Determine relative humidity by using a psychrometer chart
3. Using a psychrometer chart to evaluate the condition of the air being conditioned by an air conditioning unit.
4. Using a psychrometic chart to evaluate the condition of the air passing over the evaporator and condenser coil of an air conditioning system.
5. Comparing the air of the conditioned space before and after it has passed over the evaporator coil of an air conditioning unit.
6. Calculate different properties of air with the help of Psychrometric charts and use of steam tables.

B. SERVICING AND TESTING PROCEDURES OF AIR CONDITIONING SYSTEMS 48 Hours

7. Installing a window air conditioning unit
8. Servicing a window air conditioning unit
9. Testing and adjusting a window air conditioning unit
10. Checking and connecting a window air conditioning units electrical circuit
11. Evacuation of a window air conditioning unit
12. Add oil to compressor of a window air conditioner unit
13. Charging refrigerant in a window air conditioning unit
14. Test a window air conditioning unit fan motor
15. Test overload and relay in a window air conditioning unit
16. Leak test a window air conditioning unit
17. Study split air conditioners and its installation techniques
18. Study remote condensing unit and standard installation practices
19. Evaluating the efficiency of an air-cooled condenser
20. Evaluating the response of an air conditioning unit's sealed system due to load changes in the outdoor ambient air temperature.
21. Evaluating the performance of an air-cooled condenser
22. Determining the operational high-side pressure of an air conditioning unit with a standard air-cooled condenser.
23. Determine the operational high-side pressure of an air conditioning unit with a high efficiency air-cooled condenser.

C. SIMULATION 30 Hours

24. Troubleshooting of air conditioning systems by computer simulation program

Fault conditions

The air-conditioning system operates under the following selected fault conditions. Demonstrate to show and how the system operates every student perform the repair of fault data (fault activity, log-on time, repair actions, etc.) using the demo fault computer simulation program.

23.1 Refrigerant undercharge due to leak
23.2 Refrigerant overcharge
23.3 Compressor stuck (locked rotor)
23.4 Evaporator coil dirty
23.5 Condenser coil dirty
23.6 Air filter dirty
23.7 Compressor valve defective
23.8 Capillary tube partially restricted
23.9 TX valve stuck open
23.10 TX valve power element dead
23.11 Thermostat stuck open
23.12 Start relay coil open
23.13 Compressor run winding shorted to ground
23.14 Contactor contact high-resistance
23.15 Indoor fan motor relay coil open
23.16 Outdoor fan motor winding open
23.17 Control transformer primary winding open
23.18 Indoor fan motor run capacitor open
23.19 Contactor coil open
23.20 Defective circuit breaker

HVAC-223: **APPLIED THERMODYNAMICS IN HVAC&R SYSTEMS**

T	P	C
2	3	3

Total contact hours

Theory 64 hours
Practical 96 hours

Prerequisites: Knowledge of fundamentals of applied science and applied mathematics.

AIM: 1. To enable the student to acquire basic knowledge of thermodynamics applied to air conditioning, heating and expansion of gases, Laws of perfect gases, air cycles and reversibility.

2. To familiarize with the basic knowledge of low pressure boiler, application of boiler in air conditioning, its controls, chemical treatment of boilers/ water and feed water tanks.

1. THERMODYNAMICS PROCESSES 10 Hours

1.1 Introduction of temperature, pressure, gases and vapour.
1.2 Laws of perfect gases, gas equation and specific heat of gases.
1.3 Energy equation of a gas.
1.4 Change in internal energy.
1.5 Graphical representation of work done by a gas.
1.6 Reversible & Irreversible Processes
1.7 Constant volume process, constant pressure process, isothermal process, hyperbolic process, isentropic process, polytropic process ($PV^n = C$), free expansion, and throttling process.
1.7 Problem solving.

2. AIR CYCLES 08 Hours

2.1 Cycle of operation.
2.2 Otto cycle and its efficiency.
2.3 Carnot's cycle and its efficiency.
2.4 Joule's cycle and its efficiency.
2.5 Rankin Cycle & Its Efficiency
2.6 Mean Effective Pressure. M. E. P.
2.7 Problem solving.

3. RECIPROCATING AIR COMPRESSOR. 8 Hours

3.1 Air compressors.
3.2 Classification of compressors.
3.3 Effect of the type of compression.
3.4 Inter-Cooling
3.5 Single stage compression and multistage compression.
3.6 Work done per cycle and power required using PV diagram method.
3.7 Efficiency of a compressor volumetric efficiency.
3.8 Conditions for maximum efficiency.

3.9 Problem solving.

4. PROPERTIES OF FLUID AND FLOW OF FLUID. 8 Hours

4.1 Properties of fluid.
4.2 The four stages of substance.
4.3 Properties of vapour.
4.4 Equation of continuity.
4.5 Pressure head, velocity head, datum head, and total head.
4.6 Bernoulli's theorem.
4.7 Flow through orifices. coefficients due to contraction, velocity, and discharge.
4.8 Problem solving.

5. BOILERS 20 Hours

5.1. Definition of boiler.
5.2. Classification and types of boilers.
5.3. Low pressure boilers.
5.4. Difference between high pressure and low-pressure boilers.
5.5. Fitting and accessories of boilers.
5.6. Application of low-pressure boilers in air conditioning.
5.7. Types of boilers used in air conditioning.
5.8. Importance of boilers in winter and summer air conditioning.
5.9. Types and uses of steam traps in air conditioning.
5.10. Controls used in low pressure boilers, (Multiple timer),
5.11. Safety valves, flame detection devices, (Photo cell).
5.12. Adjustment of flame with the help of linkage of reversing motor.

6. WATER TREATMENT 6 Hours

6.1 Importance of water treatment in air-conditioning.
6.2 Chemical treatment of boilers.
6.3 Blow down and shut down procedure of boiler.
6.4 Use of chemical by-pass feeder for steam/hot water lines. Condensate tank and feed water tank for boilers.
6.5 Use of water softener in air-conditioning (single/double).

7. ELECTRICAL CIRCUITS 4 Hours

7.1 Elementary electric circuit diagram of low-pressure boiler panel.
7.2 Actual electric circuit diagram of low-pressure boiler panel.
7.3 General features and remedies of low-pressure boiler.

REFERENCE BOOKS

1. Thermodynamics by R.S. Khurmi
2. Heat Engines by D.A. Low.
3. ASHRAE Handbook- Equipment, System and Application volumes.
4. Applied Thermodynamics by T. D. Eastop & McKonkey
5. Manual prepared by National Institute of Science & Technology (NISTE), Ministry of Education, Government of Pakistan, Islamabad

HVAC-223: **APPLIED THERMODYNAMICS IN HVAC&R SYSTEMS**

INSTRUCTIONAL OBJECTIVES:

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

1. UNDERSTAND THE THERMODYNAMICS PROCESSES

- 1.1 Define absolute temperature, units of heat, pressure, gases and vapours.
- 1.2 Explain the laws of perfect gases, derive gas equation and define specific heat of gases.
- 1.3 Explain energy equation of a gas.
- 1.4 State change in internal energy
- 1.5 Represent graphically the work done by a gas.
- 1.6 Explain Reversible & Irreversible Processes
- 1.7 Explain heating and expanding process of gases.
- 1.8 Solve Problems.

2. UNDERSTAND THE PRINCIPLES OF AIR CYCLES

- 2.1 Describe cycle of operation.
- 2.2 Explain Otto standard cycle and its efficiency.
- 2.3 Explain Carnot's cycle and its efficiency.
- 2.4 Explain Joule's cycle and its efficiency.
- 2.5 Explain Rankin Cycle & Its Efficiency
- 2.6 Explain Mean Effective Pressure. (M.E.P.)
- 2.7 Solve problems

3. UNDERSTAND THE RECIPROCATING AIR COMPRESSORS

- 3.1 Explain air compressors.
- 3.2 Classify compressors.
- 3.3 State the effect of the type of compression.
- 3.4 Describe Inter-Cooling
- 3.5 Explain single stage compression and multistage compression
- 3.6 Explain work done per cycle and power required, using PV diagram method.
- 3.7 Define volumetric efficiency of a compressor.
- 3.8 Explain conditions for maximum efficiency.
- 3.9 Solve problems.

4. UNDERSTAND THE PROPERTIES OF FLUID AND FLOW OF FLUID.

- 4.1 State properties of fluid.
- 4.2 Define the four stages of substance.
- 4.3 State properties of vapour.
- 4.4 Explain equation of continuity.
- 4.5 Define pressure head, velocity head, datum head, and total head.
- 4.6 Explain Bernoulli's theorem.
- 4.7 Describe flow through orifices. Calculate coefficients due to contraction, velocity, and discharge.
- 4.8 Solve problems.

5. UNDERSTAND THE BOILER AND ITS TYPES.

5.1 Define boiler.
5.2 Explain classification of boilers.
5.3 State low-pressure boilers.
5.4 Differentiate between high pressures, low-pressure, hot water boilers.
5.5 Identify fittings and accessories of boilers.
5.6 Explain the application of low-pressure boilers in air conditioning.
5.7 Enlist the types of boilers used in air conditioning.
5.8 Explain the Importance of boilers in winter and summer air conditioning.
5.9. Explain the types and uses of steam traps in air conditioning.
5.10 Explain the controls used in low-pressure boilers, (multiple timer),
5.11 Define the safety valves, flame detection devices, (photo cell).
5.12 Explain the adjustment of flame with the help of linkage of reversing motor.

6. UNDERSTAND THE IMPORTANCE OF WATER TREATMENT.

6.1 Explain the importance of water treatment in air-conditioning.
6.2 Describe the chemical treatment of boilers.
6.3 Explain the blow down and shut down procedure of boiler.
6.4 Describe the use of chemical by-pass feeder for steam/hot water lines, condensate tank and feed water tank for boilers.
6.5 Explain the use of water softener in air-conditioning

7. UNDERSTAND THE ELECTRICAL CIRCUITS OF BOILER CONTROL PANEL.

7.1 Describe elementary electric circuit diagram of low pressure boiler panel.
7.2 Draw actual electric circuit diagram of low pressure boiler panel.
7.3 Explain general features and remedies of low pressure boiler.

HVAC-223: **APPLIED THERMODYNAMICS IN HVAC&R SYSTEMS**

LIST OF PRACTICAL **Total 96 Hours.**

On completion of this course, the trainees will be able to;

Note: Study and solution of problems are supported by TLR (Theory).

1. Solve problems on temperature, pressure measurements & heating of gases
2. Solve the problems on gas laws and work done by a gas.
3. Solve the problems on gas laws and methods of heating of gases.
4. Study of pv diagram, and thermodynamic reversibility of air cycle.
5. Solve the problems on Otto Cycle, Carnot's cycle, Joule's cycle, Rankin Cycle, air standard efficiency of these cycles and mean effective pressure.
6. Study of reciprocating air compressors and solve problems on efficiency and other conditions of compressor.
7. Study of properties of fluids and vapors, solve problems on continuity of flow, Bernoulli's theorem
8. Solve Problems on Orifices, Co-Efficient Due to Contraction, Velocity and Discharge
9. Draw neat labeled, free hand sketches of different types of boiler's fittings
10. Draw the neat labeled, free hand sketches of different types of boilers showing its mountings
11. Sketch the boiler accessories.
12. Solve the problems on steam boiler horse power and boiler efficiency.
13. Study of water treatment plants & sketch the line diagram of the system.
14. Study of controls used in low pressure boiler (multiple timer, safety release valves, photocells and flame adjustment).
15. Study of elementary and actual electric circuit diagrams of low pressure boilers.
16. Test oil pump efficiency with oil pressure gauge
17. Testing boiler venting with air draft gauge
18. Make a stack flue gas analysis (CO_2, SO_2 & O).
19. Install and operate a blower type gas burner with electric ignition.
20. Install and operate a gun type oil burner.
21. Remove, clean and replace an oil burner nozzle.
22. Locate trouble in a gas burner system.
23. Industrial Visit to study Boiler Operation & Parts

HVAC-233: ENGINEERING, ARCHITECTURAL, & COMPUTER AIDED DRAWING

T	P	C
1	6	3

Total contact hours

Theory 32 hours
Practical 192 hours

Pre-requisites: Fundamental knowledge of technical drawing

AIM: The course has been designed to give the technicians an understanding of engineering and architectural drawing for installing & troubleshooting an HVAC&R system along with familiarity with AutoCAD Software:

a. Read and Interpret Engineering
b. Read & Interpret Architectural drawings.
b. Execute simple working drawings related to HVAC&R systems.
c. Understand the installation drawings of air conditioning system
d. Know the architectural drawing of buildings & graphical symbols used in plumbing & HVAC&R Systems.

1. ENGINEERING DRAWING 6 Hours

1.1 Introduction to Engineering Drawing
1.2 Introduction to Architectural Drawing
1.2 Sectional views and its types
1.3 Sketching and drawing in isometric and orthographic projections of piping system.
1.4 Representation of inclined and curved surfaces.
1.5 Development of surfaces like truncated pipes, intersection; of two pipe, square and rectangular ducts.

2. SYMBOLS FOR PIPING, PIPE FITTINGS, VALVES & DUCTING 14 Hours

2.1 Graphical symbols used in plumbing and HVAC&R system drawings
2.2 Electrical Symbols used in Engineering Drawing
2.3 Representation of Pipes and ducts hanging with roof and walls
2.4 Types of wall brackets and roof clamps
2.5 Pipe lines drawings, using pipe fitting symbols (single line and double line)
2.6 Pipe fittings, study and use of screwed, flanged and welded ends pipe connections
2.7 Pipes and piping system drawings
2.8 Ducting system drawings
2.9 Pipes and types of pipes like welded, seamless, concrete and ceramics
2.10 Valves and their types like globe, gate, check, cock, and relief etc. and their end connections
2.11 Graphical representation of pipe fitting symbols
2.12 Identification of piping and ducting by color code system and Greek alphabets.

3. ARCHITECTURAL DRAWING 6 Hours

3.1 Description of soil, RCC walls, and building plans
3.2 Type of doors and windows
3.3 Types of residential, public, educational, industrial and commercial buildings.
3.4 Working drawings - elevation, plans and sectional views of buildings.

4. COMPUTER AIDED DRAWING 6 Hours

4.1 Introduction to CAD software
- 4.1.1 Initial Screen: Title Bar, Menu Bar, Scroll Bar, Toolbar, Command Line, and Drawing Area
- 4.1.2 Overviews: Pull Down Menus and Dialog Boxes
- 4.1.3 Help command
- 4.1.4 File save
- 4.1.5 File print
- 4.1.6 Edit
- 4.1.7 Modify

4.2 Introduction to 2D CAD Fundamentals
- 4.2.1 Points and lines
- 4.2.2 Array
- 4.2.3 Dots in space
- 4.2.4 A lightening block
- 4.2.5 Shapes
- 4.2.6 Extending lines
- 4.2.7 Expanding, circles and rectangles
- 4.2.8 Circle, Arcs and Polygons
- 4.2.9 Dimensioning
- 4.2.10 Text
- 4.2.11 Blocks
- 4.2.12 Scale, Rotate, Copy and Move
- 4.2.13 Hatching and Coloring
- 4.2.14 Fill Command
- 4.2.15 Layers
- 4.2.16 Limits
- 4.2.17 Printing & Plotting

RECOMMENDED BOOKS:

1. Fundamental of Pipe drafting By Charles M. Thomson
2. ASHRAE Hand Book- Fundamental Volume
3. First Year Engineering Drawing By A. C. Parkinson
4. Building Construction By Arrora
5. Introduction to Auto CAD Basics (latest version)

HVAC-233: ENGINEERING, ARCHITECTURAL, & COMPUTER AIDED DRAWING

INSTRUCTIONAL OBJECTIVES:

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

1. UNDERSTAND THE CONCEPT OF ENGINEERING & ARCHITECTURAL DRAWING AND DRAW ISOMETRIC, ORTHOGRAPHIC, SECTIONAL VIEWS AND DEVELOPMENT OF SURFACES.

1.1 Explain the role of Engineering & Architectural Drawing.
1.2 Explain sectional views and their types
1.3 State sectional views
1.4 Explain isometric projection of a piping system
1.5 Explain orthographic projection of a piping system
1.6 Explain inclined and curved surfaces
1.7 Describe development (laying out) of inclined and curved surfaces by parallel line, triangulation, and radial line methods.

2 UNDERSTAND THE PIPES, PIPE FITTINGS, VALVES, DUCTING, PIPES/DUCTS HANGING SYSTEM AND THE SYMBOLS USED IN HVAC&R INSTALLATIONS

2.1 Explain Graphical symbols used in plumbing and HVAC&R system drawings
2.2 Explain Electrical Symbols used in Engineering Drawing
2.3 Explain Representation of Pipes and ducts hanging with roof and walls
2.4 Explain Types of wall brackets and roof clamps
2.5 Explain Pipe lines drawings, using pipe fitting symbols (single line and double line)
2.6 Explain Pipe fittings, study and use of screwed, flanged and welded ends pipe connections
2.7 Explain Pipes and piping system drawings
2.8 Explain Ducting system drawings
2.9 Explain Pipes and types of pipes like welded, seamless, concrete and ceramics
2.10 Explain Valves and their types like globe, gate, check, cock, and relief etc. and their end connections
2.11 Explain Graphical representation of pipe fitting symbols
2.12 Explain Identification of piping and ducting by color code system and Greek alphabets.

3. UNDERSTAND THE WORKING DRAWINGS OF BUILDING PLANS, EVALUATION, SECTION, BUILDING PLANNING AND CONSTRUCTION.

3.1 Explain the soil and its types
3.2 Explain the types of doors and windows
3.3 State the method of drawing symbols of doors and windows
3.4 Explain the types of building.
3.5 State the method of drawing the elevations, plans and sectional views of buildings.

4. UNDERSTAND THE COMPUTER AIDED DRAWING

4.1 Explain Auto CAD software
4.1.1 Explain Initial Screen: Title Bar, Menu Bar, Scroll Bar, Toolbar, Command Line, and Drawing Area

- 4.1.2 Explain Overviews: Pull Down Menus and Dialog Boxes
- 4.1.3 Explain Help command
- 4.1.4 Explain File save
- 4.1.5 Explain File print

4.2 Explain the Graphic Fundamentals

- 4.2.1 Explain Points and lines
- 4.2.2 Explain Dots in space
- 4.2.3 Explain A lightening blot
- 4.2.4 Explain Shapes
- 4.2.5 Explain Expanding lines, circles and rectangles

HVAC-233: ENGINEERING, ARCHITECTURAL, & COMPUTER AIDED DRAWING

GENERAL OBJECTIVES

1. To enable the students to understand architectural drawings of different buildings.
2. The students will be able to read and understand the working drawings of building plans, elevation and sections.
3. They will be able to visualize the problems regarding running of ducts, pipes, electrical installations and equipments, etc.
4. The students will be able to understand the building planning and construction, installation symbols used for refrigeration and air conditioning installations.

Pre-requisites. Technical drawing, MT-111

LIST OF PRACTICALS 192 Hours

On completion of this course, the trainees will be able to;

1. DRAW THE DEVELOPMENT OF DIFFERENT SURFACES.

1.1 Inclined and curved surfaces (layout patterns) by parallel line, triangulation and radial line methods.
1.2 Tee joints (round pipe tee).
1.3 pipe joints (Intersecting pipes).
1.4 Square and rectangular ducts, truncated cone, pipes & ducts, and transition pieces etc.
1.5 Symbols of components/equipment used in HVAC&R Systems.

2. DRAW

2.1 Orthographic drawings of a piping system.
2.2 Draw isometric views of a piping system.
2.3 Single line piping.
2.4 Double line piping
2.5 Drawing of electrical symbols

3. DRAW PLAN, ELEVATION, AND SECTIONS OF BUILDINGS

3.1 Showing doors, windows and other arch. symbols etc.
3.2 Different types of buildings.

4. DRAW COMPUTER AIDED DRAWINGS

4.1 Drawing Techniques
- 4.1.1 Setup a new file, Select Wizard, or Template
- 4.1.2 Units selection, drawing limits and drawing aids

4.2 Draw commands
- 4.2.1 Arc, Circle, Ellipse, Line, Multi Line, Polyline, Rectangle, Spline, Text
- 4.2.2 Relative and Absolute Coordinates

4.2.3 Cartesian and Polar Coordinates
4.2.4 Drawing Colors
4.2.5 Line Types
4.2.6 Blocks and Attributes
4.2.7 Layers
4.2.8 Hatching
4.2.9 Dimensions
4.2.10 Simple 3D Drawing
4.2.11 Solid Command
4.2.12 Isometric Drawing
4.2.13 Inquiry Command
4.2.14 Redraw and Regain Command
4.2.15 Fill Command
4.2.16 Limits
4.2.17 Printing & Plotting

5. DRAW SYMBOLS FOR PIPING, PIPE FITTINGS PLUMBING, AND HVAC&R DUCTING SYSTEM

5.1 Identification of piping and ducting by colour and alphabets.
5.2 To draw the diagram of piping and their fixtures.

HVAC-243: ADVANCE REFRIGERATION

T	P	C
3	0	3

Total contact hours:

Theory 96 hours

Prerequisites: Knowledge of principles of refrigeration.

AIMS:

a) The aims of the course are to help the students, to understand the advance theory of refrigeration, application of actual refrigeration system, special installations and design feature of cold storage

b) Acquire knowledge of the different refrigeration installation, causes of food spoilage, their remedies and problems in handling cold storage.

c) Design cold storage by means of calculations.

1. CONVENTIONAL VAPOR COMPRESSION SYSTEM 6 Hours

1.1 Types of compression system.
1.2 Conventional compression system using automatic expansion valve as refrigerant control.
1.3 Compression system using thermostatic expansion valve as refrigerant control.
1.4 Low side float valve with reciprocating and rotary compressor system.
1.5 High side float valve and capillary tube system.

2. WATER CHILLER (AIR COOLED/WATER COOLED) 10 Hours

2.1 Double pipe
2.2 Baudlot and tank type cooler.
2.3 Shell and tube chiller.
2.4 Dry expansion chiller.
2.5 Spray type chiller.
2.6 Direct and indirect system
2.7 Secondary Refrigerants.
2.8 Brine.
2.9 Antifreeze solution.
2.10 Cryogenic fluids.
2.11 Cryogenic applications.

3. DEFROSTING. 8 Hours

3.1 Defrosting intervals.
3.2 Methods of defrosting.
3.3 Water defrosting.
3.4 Electric defrosting.
3.5 Hot gas defrosting.
3.6 Re-evaporator coils.
3.7 Defrosting multiple evaporator systems.
3.8 Reverse cycle defrosting.
3.9 Heat bank defrosting.
3.10 Vapor defrosting.

4. METHODS OF OBTAINING ULTRA-LOW TEMPERATURE 6 Hours

4.1 Cascade System
4.2 Multi stage (booster) compression
4.3 Two stage and multistage system.
4.4 Multi temperature system.
4.5 Intercooler.

5. TRANSPORT REFRIGERATION AND AIR CONDITIONING. 6 Hours

5.1 Truck refrigeration
5.2 Marine refrigeration
5.3 Automobile (car) air-conditioning.
5.4 Railway car air conditioning.
5.5 Air craft air conditioning.

6. COMMERCIAL SYSTEM APPLICATION. 6 Hours

6.1 Reach-in-cabinet.
6.2 Walk-in-cabinet.
6.3 Florist cabinet.
6.4 Display cases, single duty, double duty cases.
6.5 Ice cream cabinet.
6.6 Automatic Ice Maker and its types.
6.7 Vending Machine.

7. FOOD PRESERVATION. 9 Hours

7.1 Principles of food preservation.
7.2 Deterioration and spoilage.
7.3 Enzymes.
7.4 Micro-organisms.
7.5 Bacteria.
7.6 Yeasts.
7.7 Molds.
7.8 Control of spoilage agents
7.9 Preservation of food by refrigeration (low temperature) and by high temperature .

8. REFRIGERATED STORAGE. 9 Hours

8.1 Refrigerated storage
8.2 Storage conditions.
8.3 Storage temperature.
8.4 Humidity and air motion.
8.5 Mixed storage.
8.6 Product condition on entering storage.
8.7 Product chilling and pre-cooling.
8.8 Relative humidity and air velocity in chill rooms.
8.9 Freezing and frozen storage.

9. FREEZING METHODS. 6 Hours

9.1 Freezing methods and preparing food stuff before preservation.

9.2 Air blast freezing.
9.3 Indirect contact freezing.
9.4 Immersion freezing.
9.5 Comparison between Quick freezing and Sharp freezing
9.6 Packing material and containers.

10. FOOD PRODUCTS. 6 Hours

10.1 Cold storage practice for vegetables.
10.2 Cold storage practice for fruits.
10.3 Cold storage practice for meat, fish , poultry , milk and their products.

11. FACTORS DETERMINING THE LOAD. 9 Hours

11.1 Cooling load
11.2 Equipment running time.
11.3 Cooling load calculations.
11.4 Wall gain load.
11.5 Air change load.
11.6 Product load.
11.7 Miscellaneous load.

12. COOLING LOAD CALCULATIONS FOR COLD STORAGES 6 Hours

12.1 Factors determining the wall gain load.
12.2 Determination of "U" factor.
12.3 Temperature differential across cold storage walls.
12.4 Temperature differential across ceilings and floors.
12.5 Effect of solar radiation.
12.6 Calculating the wall gain load.
12.7 Calculating the air change load.
12.8 Vapor pressure and vapor transmission

13. PRODUCT LOAD. 6 Hours

13.1 Calculating the product loads.
13.2 Chilling rate factor.
13.3 Product freezing and storage.
13.4 Respiration heat.

14. MISCELLANEOUS LOAD. 3 Hours

14.1 Calculating the miscellaneous load.
14.2 Use of safety factor.
14.3 Short method load calculations.
14.4 Metric calculation.
14.5 Customary problems.

REFERENCE BOOKS

1. Principles of Refrigeration by R.J.Dossot.
2. Modern Refrigeration and Air Conditioning by Althouse.
3. ASHRAE Handbook – Fundamentals 2005.

4. Refrigeration & Air conditioning (A text book) by R.S. Khurmi, and J.K. Gupta.
5. Manual prepared by National Institute of Science & Technology (NISTE), Ministry of Education, Government of Pakistan, Islamabad.

HVAC-243: ADVANCE REFRIGERATION

INSTRUCTIONAL OBJECTIVES:

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

1. UNDERSTAND THE CONVENTIONAL COMPRESSION SYSTEM

1.1 Enlist the type of compression system.
1.2 Explain conventional compression system using automatic expansion valves.
1.3 Explain conventional compression system using thermostatic expansion valve.
1.4 Explain low and high side float valve with reciprocating compressor.
1.5 Explain low and high side float valve with Rotary compressor.

2. UNDERSTAND THE PRINCIPLE OF OPERATION, CONSTRUCTION AND UTILIZATION OF WATER CHILLER IN COMMERCIAL AND INDUSTRIAL REFRIGERATION.

2.1 Enlist the type of water chiller.
2.2 Explain the working principle of double pipe water chiller.
2.3 Explain the working principle of Banudlot and tank type coolers.
2.4 Explain the working principle/operation of shell and tube chiller.
2.5 Explain the working principle/operation of dry expansion chiller.
2.6 Explain the working principle/operation of spray type chiller.
2.7 Distinguish between direct and in direct system.
2.8 State the use of secondary refrigerants.
2.9 Enlist the function and purpose of brine solution.
2.10 Define antifreezing solution.
2.11 Describe cryogenic fluid.
2.12 Explain application of cryogenics.

3. UNDERSTAND THE METHODS OF DEFROSTING

3.1 Explain the purpose of defrosting.
3.2 Identify the different types of defrosting method.
3.3 Explain water defrosting method
3.4 Explain electric defrosting method.
3.5 Explain hot gas defrosting method.
3.6 Describe re-evaporator coils.
3.7 Explain defrosting multiple evaporator system.
3.8 Illustrate reverse cycle defrosting.
3.9 State heat bank defrosting.
3.10 State vapor defrosting.

4. UNDERSTAND THE METHODS OF ULTRA-LOW TEMPERATURE

4.1 Explain Cascade system.
4.2 Explain multistage (booster) compression.
4.3 Explain the two stage and multistage system.
4.4 Explain the multi temperature system.
4.5 Explain Intercoolers.

5. UNDERSTAND THE DIFFERENT TYPES OF TRANSPORT REFRIGERATION AND AIR CONDITIONING SYSTEMS.

5.1 State the purpose of transport refrigeration and air-conditioning.
5.2 Explain truck refrigeration.
5.3 Explain marine refrigeration.
5.4 Explain automobile (car) air conditioning.
5.5 Explain railway car air conditioning.
5.6 Explain air craft air conditioning.

6. UNDERSTAND THE USE OF COMMERCIAL SYSTEM APPLICATION

6.1 Enlist commercial type of refrigerating units.
6.2 Explain the use and function of reach-in cabinet.
6.3 Explain the use and function of walk-in cabinet.
6.4 State the use and function of florist cabinet.
6.5 Differentiate between single duty display cases and double duty display cases.
6.6 Identify the different components of ice cream cabinet.
6.7 Identify different component of automatic ice maker.
6.8 Explain milk vending machine.

7. UNDERSTAND THE FOOD PRESERVATION METHODS.

7.1 Describe the principles and importance of food product preservation.
7.2 Describe deterioration and spoilage of food.
7.3 Define enzymes, micro-organisms, bacteria, yeast and mold.
7.4 Explain the control of spoiling agents.

8 UNDERSTAND THE REFRIGERATED STORAGE TECHNIQUES.

8.1 Explain refrigerated space.
8.2 Enlist the storage conditions of meat product.
8.3 Enlist the storage temperature of different vegetables.
8.4 Describe humidity and air motion.
8.5 Explain relative humidity and air motion in chill rooms.

9 UNDERSTAND THE FREEZING METHODS, PREPARING FOOD STUFF BEFORE PRESERVATION AND PACKING MATERIALS.

9.1 Enlist the methods of freezing and preparing of food product before preservation.
9.2 Explain air blast freezing.
9.3 State indirect contact freezing.
9.4 State immersion freezing.
9.5 Differentiate between quick freezing and sharp freezing.
9.6 Explain packing materials.

10 UNDERSTAND THE COLD STORAGE PRACTICES FOR DIFFERENT TYPES OF VEGETABLE, FRUITS, MEATS, MILK AND THEIR PRODUCTS.

10.1 Explain the methods of cold storage Practice for vegetable.
10.2 Explain the methods of cold storage Practice for fruits.
10.3 Explain the methods of cold storage Practice for meat/poultry.
10.4 Explain the methods of cold storage Practice for fisheries and milk products.

11. UNDERSTAND THE FACTORS FOR DETERMINING THE HEAT LOAD.

11.1 Enlist the factors while calculating cooling load of any type of cold storage.
11.2 State equipment running time.
11.3 Explain the wall gain load.
11.4 Explain the air change load.
11.5 Explain the product load.
11.6 Explain the miscellaneous load.

12. CALCULATE THE COOLING LOAD FOR COLD STORAGES

12.1 Identify the factors determining the wall gain load.
12.2 Calculate U factor.
12.3 Explain the temperature differential across cold storage wall.
12.4 Explain the temperature differential across ceiling and floor.
12.5 Explain the effect of solar radiation.
12.6 Calculate the wall gain radiation.
12.7 Calculate the air gain load.

13. CALCULATE THE PRODUCT LOAD.

13.1 Manipulate product load.
13.2 Describe chilling rate factor.
13.3 Explain respiration heat.

14. CALCULATE THE COOLING LOAD OF MISCELLANEOUS PRODUCTS OF COLD STORAGE

14.1 Calculate the miscellaneous load.
14.2 Explain the short method load calculations.
14.3 Apply metric system for calculating the cooling load.

HVAC-253**:** **HVAC&R WORKSHOP PRACTICE - II**

T	P	C
1	6	3

Total contact Hours:

Theory 32 Hours
Practical 192 Hours

Prerequisites: Understand the servicing, trouble shooting of domestic refrigeration machines and their remedies.

AIMS:

1. At the end of the course, the students will have acquired the ability of repair, servicing, maintenance and installation of parts used in domestic refrigeration machines and air conditioning equipment.
2. Trouble shooting in refrigeration machines and suggest their remedies.
3. Understand electric circuits of refrigeration machines and window air conditioners.

1. REPAIRING, SERVICING AND RECHARGING OF REFRIGERATION EQUIPMENT 6 Hours

1.1 Mechanical parts of domestic refrigeration machines.
1.2 Replacing & Installation of parts
1.3 Leak detection methods
1.4 Evacuation methods
1.5 Re-changing of Compressor Oil & Charging of Refrigerant Gas

2. CONSTRUCTION FEATURES OF CABINET OF REFRIGERATION & AIR CONDITIONING EQUIPMENT 5 Hours

2.1 Refrigerator body
2.2 Deep freezer
2.3 Display cabinet and its types.
2.4 Window air conditioner
2.5 Split air conditioner – Heat pump.
2.6 Water cooler
2.7 Automobile Air conditioning Unit

3. DRAWING ELECTRICAL CIRCUITS OF REFRIGERATION AND AIR CONDITIONING EQUIPMENT 5 Hours

3.1 Basic control and power circuit
3.2 AC single phase motor starter circuit
3.3 Domestic refrigerator
3.4 Deep freezer
3.5 Display Cabinet
3.6 Domestic window type air conditioner
3.7 Split type (heat pump) air conditioner
3.8 Multiple (hot and cold) water cooler
3.9 Ice cube maker and ice cream freezing dispenser

4. REFRIGERANT RECOVERY, RECYCLING & RECLAIMING 6 Hours

4.1 Chlorofluorocarbons (CFC's), hydrochlorofluorocarbons (HCFC's) and the ozone layer
4.2 Recovery, recycling, reclaiming of refrigerants
4.3 Refrigerant recovery equipment
4.4 Refrigerant cycling equipment
4.5 Refrigerant reclaiming procedure
4.6 CFC's recovery/recycle/reclaim safety and standards

5. TROUBLESHOOTING OF REFRIGERATION SYSTEMS 7 Hours

5.1 Electrical Faults
- 5.1.1 Compressor does not start
- 5.1.2 Compressor operates intermittently
- 5.1.3 Compressor starts and runs but cycles on protector
- 5.1.4 Starting capacitor burnt out
- 5.1.5 Running capacitor burnt out
- 5.1.6 Motor controls defective
  - Low side pressure motor control
  - High side pressure safety motor control
- 5.1.7 Relays burnt-out
- 5.1.8 Defective heater
- 5.1.9 Defective switches
- 5.1.10 Defective Overload Protector

5.2 Mechanical Faults
- 5.2.1 Shortage of Refrigerant
- 5.2.2 Leakage
- 5.2.3 Moisture in the refrigerant circuit
- 5.2.4 Restriction in Refrigerant Flow Control
- 5.2.5 Faulty gasket seal
- 5.2.6 Stuck motor compressor
- 5.2.7 Presence of oil in the evaporator

6. TROUBLE SHOOTING AND REMEDIES 3 Hours

6.1 Compressor windings
6.2 Burn-out overload, fan motors and relays
6.3 Damage of thermostats & timer

RECOMMENDED BOOK

1. Modern Refrigeration and Air-Conditioning by Althouse

HVAC-253: HVAC&R WORKSHOP PRACTICE - II

INSTRUCTIONAL OBJECTIVES:

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

1. UNDERSTAND THE PROCEDURE OF REPAIRING, SERVICING AND CHARGING THE REFRIGERATION EQUIPMENT

1.1 Enlist mechanical parts of a refrigerator
1.2 Describe the mechanical parts of a refrigerator
1.3 Explain the procedure of replacing different parts of domestic refrigeration machines
1.4 Describe leak detection methods.
1.5 Explain Evacuation methods
1.6 Explain Charging methods of domestic refrigeration machines
1.7 Explain the procedure of oil charging in domestic refrigeration machines.

2 UNDERSTAND THE CABINET CONSTRUCTION OF THE REFRIGERATION & AIR CONDITIONING EQUIPMENT

2.1 Explain the constructions of refrigerator body
2.2 Explain the construction of deep-freezer body
2.3 Explain the construction of different display cabinet
2.4 Explain the construction of window type air conditioner
2.5 Explain the construction of a split type air conditioner
2.6 Explain the constructions of water cooler
2.7 Explain the construction of Automobile Air Conditioning Unit

3. DRAWING ELECTRICAL CIRCUITS OF REFRIGERATION AND AIR CONDITIONING EQUIPMENT

3.1 Draw and explain basic control and power circuit
3.2 Draw and explain AC single phase motor starter circuit
3.3 Draw and explain electric circuit diagram of domestic refrigerator
3.4 Draw and explain electric circuit diagram of deep freezer
3.5 Draw and explain electric circuit diagram of a display cabinet
3.6 Draw and explain electric circuit diagram of domestic window type air conditioner
3.7 Draw and explain electric circuit diagram of split type (heat pump) air conditioner
3.8 Draw and explain electric circuit diagram of multiple (hot and cold) water cooler
3.9 Draw and explain electric circuit diagram of ice cube maker and ice cream freezing dispenser

4. UNDERSTAND THE REFRIGERANT RECOVERY, RECYCLING & RECLAIMING METHODS

4.1 Describe the effect of Chlorofluorocarbons (CFC's) refrigerants on the ozone layer in the atmosphere

4.2 Explain the proper procedures to recover, recycle, reclaim Chlorofluorocarbons (CFC's) refrigerants

4.3 Identify and describe various types of refrigerant recovery and recycling equipment and their uses

4.4 Enlist and explain the CFC's recovery, recycle, reclaim safety and standards refrigerant cycling equipment

4.5 Explain the procedure set forth for the service & recovery of refrigerants regarding automobile air conditioning

5. TROUBLE SHOOTING OF REFRIGERATION & AIRCONDITIONING SYSTEMS

5.1 Explain the types of expected electrical faults relating to;

5.1.1 Compressor does not start
5.1.2 Compressor operates intermittently
5.1.3 Compressor starts and runs but cycles on protector
5.1.4 Starting capacitor burnt out
5.1.5 Running capacitor burnt out
5.1.6 Motor controls defective
- Low side pressure motor control
- High side pressure safety motor control

5.1.7 Relays burnt-out
5.1.8 Defective heater
5.1.9 Defective switches
5.1.10 Defective Overload Protector

5.2 Explain the types of expected mechanical faults relating to;

5.2.1 Shortage of refrigerant
5.2.2 Leakage
5.2.3 Moisture in the refrigerant circuit
5.2.4 Restriction in Refrigerant Flow Control
5.2.5 Faulty gasket seal
5.2.6 Stuck motor compressor
5.2.7 Presence of oil in the evaporator

6. UNDERSTAND AND DIAGNOSE THE COMMON TROUBLES IN THE REFRIGERATION EQUIPMENT

6.1 Explain the various causes to burnout the compressor windings.

6.2 Explain the various common causes to burnout the overload, fan motor and relays.

6.3 Explain the causes of damage to thermostat & timer

HVAC-253**:** **HVAC&R WORKSHOP PRACTICE - II**
Total Practical Hrs- 192 Hours

Prerequisites: Workshop Practice – I
Computer Application

AIM:

1. To provide practice of refrigerating and air conditioning equipment repair, maintenance, service and their installations.
2. To locate trouble shooting in refrigerating and air conditioning equipment and suggest their remedies.
3. To acquaint the students with the electric circuits of refrigeration and air conditioning equipment.

LIST OF PRACTICALS 192 Hours

On completion of this course the trainees will be able to;

1. REFRIGERANT RECOVERY METHODS 15 Hours

1.1 Using a recovery unit to recover liquid refrigerant from a sealed system
1.2 Using a recovery unit to recover vapor refrigerant from a sealed system
1.3 System-dependent passive method of recovering refrigerant
1.4 Evacuation of refrigerant into an external cylinder

2. REFRIGERATION PROJECT 45 Hours

2.1 Component identification
2.2 Drawing skills and planning of system layout
2.3 Drawing up material list required
2.4 Changing oil in a hermitic system (if required)
2.5 Assembly of project wiring and tubing required
2.6 Pressure and leak testing of system
2.7 Evacuation
2.8 Charging of system
2.9 Taking temperatures and pressures of system
2.10 Refrigerant recovery
2.11 Weighting of refrigerant
2.12 Servicing, installation and testing of different metering devices and setting of following different components
- Capillary tube
- Automatic expansion valve
- Thermostatic expansion valve

2.13 Servicing, installation and testing of pressure controls and the setting of each
- Low pressure
- Dual pressure

2.14 Servicing, installation and testing of thermostat and solenoid valve to create a pump down system

3. SERVICE PROCEDURES OF A REFRIGERATOR **60 Hours**

3.1 Recommendations of manufacturer for refrigerators.
3.2 Checking the charge without gauges

3.3 Adding oil to a hermetic system
3.4 Evacuation of a hermetic system
3.5 Clean and flush burnout's in a refrigeration system
3.6 Check and connect refrigerator electrical system
3.7 Replace a evaporator fan motor
3.8 Replace a condenser fan motor
3.9 Replace a capillary tube in refrigeration system
3.10 Replace dehydrator in a hermetic system
3.11 Charge a refrigeration system
3.12 Leak test a refrigeration system
3.13 Service a conventional refrigeration system
3.14 Test a capacitor start hermetic motor
3.15 Test and operate a capacitor start, capacitor run hermetic compressor motor
3.16 Replace a hermetic compressor
3.17 Install and inspect a domestic system
3.18 Remove and install door hardware
3.19 Locate trouble in a manual defrost hermetic system
3.20 Locate trouble in an electric defrost system
3.21 Wire a domestic refrigerator system
3.22 Wire a domestic freezer system
3.23 Check all electrical components of a 220 volt refrigeration system

4. TROUBLE SHOOTING OF REFRIGERATION SYSTEMS BY COMPUTER SIMULATION PROGRAM 48 Hours

4.1 Fault Conditions

The refrigeration system operates under the following selected fault conditions. Demonstrate to show how the system operates and every student perform the repair of fault data (fault activity, log-on time, repair actions, etc.) using the demo fault computer simulation program

4.1.1 Refrigerant undercharge due to leak
4.1.2 Refrigerant overcharge
4.1.3 TXV power element dead
4.1.4 TXV stuck open
4.1.5 Filter-drier clogged
4.1.6 Evaporator coil extremely dirty
4.1.7 Evaporator fan blades mounted backwards
4.1.8 Condenser coil airflow blocked
4.1.9 Compressor stuck (won't start)
4.1.10 Compressor valve defective
4.1.11 CPR valve stuck closed
4.1.12 Air and moisture in system
4.1.13 Compressor run winding open
4.1.14 Compressor start winding shorted to ground
4.1.15 Compressor run and start windings shorted
4.1.16 Compressor overload stuck open
4.1.17 Compressor run capacitor shorted
4.1.18 Compressor start capacitor open
4.1.19 Start relay coil open

4.1.20 Condenser fan motor winding open
4.1.21 Evaporator fan motor winding open
4.1.22 Defrost timer motor winding open
4.1.23 Defrost timer contact DTC1 stuck open
4.1.24 Defrost thermostat stuck in terminate state
4.1.25 Defrost heater element open
4.1.26 Hot gas valve solenoid coil open
4.1.27 Liquid line solenoid coil open
4.1.28 Box thermostat/pressure state stuck open
4.1.29 High-pressure switch stuck open
4.1.30 Defective circuit breaker

5. TESTING PROCEDURES OF REFRIGERATOR AND AIR CONDITIONER COMPONENTS 24 Hours

5.1 Mechanical components
- 5.1.1 Parts of compressor motor
- 5.1.2 Condensers
- 5.1.3 Evaporators
- 5.1.4 Piping accessories
- 5.1.5 Humidity control
- 5.1.6 Valves
- 5.1.7 Accumulators
- 5.1.8 Oil separator
- 5.1.9 Pressure regulators
- 5.1.10 Temperature regulators
- 5.1.11 Mufflers
- 5.1.12 Faulty gas kit seal
- 5.1.13 Presence of oil in evaporator

5.2 Electrical components of refrigerator, air conditioner and deep freezer
- 5.2.1 Timers
- 5.2.2 Temperature controls
- 5.2.3 Fans
- 5.2.4 Switches
- 5.2.5 Heaters

RECOMMENDED BOOKS

1. Althouse, A., Turnquist C. and Bracciano. A Modern Refrigeration and Air conditioning. The Goodheart. Willcox Co., Inc., U.S.A.
2. Dossat, R.J. Principles of Refrigeration. John Wiley and Sons Inc., Tokyo Japan
3. Harris, N.C., Conde, D.F. Modern Air Conditioning. McGraw Hill Book Co., USA
4. Mcquiston F.C., Parker, J.D. Heating, Ventilating, and Air conditioning Analysis and Design. John Wiley and Sons, Inc., USA
5. Schmaltzier, Gerald and Eveling. Basic Air conditioning. Hiayden Book Co., Inc., USA
6. Computer Simulation Programs.

اسلامیات / مطالعہ پاکستان

نصاب (سال سوئم)	CODE:311	ٹی	پی	سی
حصہ اول اسلامیات		1	0	1
حصہ دوم مطالعہ پاکستان		کل وقت: 200 گھنٹے		

موضوعات:

1- قرآن مجید

سورۃ فاتحہ۔ آیۃ الکرسی۔ سورۃ البقرۃ کی آخری آیات اٰمن الرسول سے تا آخر اور سورۃ فلاق مع ترجمہ و تشریح

2- دس منتخب احادیث مع ترجمہ و تشریح

☆ بنی الاسلام علی خمس شہادت ان لا الہ الا اللہ واقام الصلوٰۃ وایتاء الزکوٰۃ وحج البیت وصوم رمضان

☆ الدین النصیحۃ

☆ المنشاء موتمن

☆ للمومن علی المومن ست خصال یعود مادام مرض و تشہدہ اذا مات ویجیبہ اذا دعا

☆ لیسلم علیہ اذا لقیہ ولیشمتہ اذا عطس و فصیحلہ اذا غاب او شہد

☆ لا یدخل من خلقک

☆ لا یدخل الجنۃ قاطع

☆ ان اللہ حرم علیکم عقوق الامہات واضاعۃ البنات

☆ لیسروا ولا تعسروا ولا تنفروا

☆ ذاق طعم الایمان من رضی باللہ وبالاسلام دینا وبمحمد نبیا

☆ افضل الذکر لا الہ الا اللہ

3- حقوق و فرائض

حصول تعلیم بطور فرض۔ والدین اور اولاد کے حقوق و فرائض۔ ہمسایہ کے حقوق

4- اسلام کی اخلاقی اقدار

صبر و استقلال۔ غصہ و غدر۔ ایفائے عہد۔ امانت۔ ایثار و قربانی

سال سوئم
حصہ اول اسلامیات

تدریس مقاصد

قرآن حکیم
عمومی مقصد: منتخب سورتوں اور آیات کی روشنی میں اسلام کے بنیادی مقاصد اور عبادات جان سکے
خصوصی مقاصد: طالب علم اس قابل ہو جائے گا کہ
سورۃ الفاتحہ: آیۃ الکرسی۔ سورۃ بقرۃ کی آخری آیات از امن الرسول سے اور سورۃ اخلاق کا ترجمہ و تشریح کر سکے
طالب علم درج ذیل کا مفہوم بیان کر سکے

☆ رب العالمین صرف اللہ تعالیٰ ہے
☆ اللہ رحم کرنے والا ہے
☆ قیامت کے دن بادشاہی اللہ کی ہو گی
☆ عبادت اور استعانت کا حقدار صرف اللہ ہے

طالب علم درج ذیل کا مفہوم بیان کر سکے

☆ اللہ پاک ہر عیب سے پاک ہے
☆ اللہ کے اسمائے حسنہ حق اور قیوم ہیں
☆ تعلیم انبیاء پر ایمان لانا ضروری ہے
☆ رسول، ملائکہ، کتب سماویہ پر ایمان لانا فرض ہے
☆ اطاعت حقیقی صرف اللہ کے لیے ہے
☆ اسلامی احکامات پر عمل کرنا انسانی بہبود میں ہے
☆ کفر کو اللہ کی مدد کے بغیر شکست نہیں دی جا سکتی
☆ اللہ ایک ہے
☆ اللہ کسی کا محتاج نہیں نہ اس کا کوئی شریک ہے

منتخب احادیث
عمومی مقصد: احادیث کی روشنی میں اسلامی تعلیمات پر عمل پیرا ہو سکے
خصوصی مقصد:

☆ احادیث کا ترجمہ بیان کر سکے

- ☆ احادیث کی تشریح کر سکے
- ☆ معاشرتی اور انفرادی زندگی میں احادیث سے راہنمائی حاصل کر سکے

حقوق و فرائض

عمومی مقصد: اسلامی معاشرے کا ایک اچھا فرد بن سکے

خصوصی مقاصد:

- ☆ والدین کے حقوق و فرائض بیان کر سکے
- ☆ ہمسایوں کے حقوق بیان کر سکے
- ☆ اسلام میں حقوق و فرائض کی صورت میں اپنے اندر خدمت خلق کا جذبہ پیدا کر سکے

اسلامی اقدار

عمومی مقصد: طالب علم جان سکے گا کہ تعلیم کا مقصد حسن اخلاق سے متصف ہوتا ہے

خصوصی مقاصد

- ☆ اخلاق کے معنی و مفہوم کو بیان کر سکے
- ☆ اسلام میں حسن اخلاق کی اہمیت بیان کر سکے
- ☆ قرآن و سنت کی روشنی میں صبر و استقلال کی اہمیت بیان کر سکے
- ☆ اسلام میں عفو و درگزر کی اہمیت بیان کر سکے
- ☆ ایفائے عہد کی اہمیت بیان کر سکے
- ☆ اخوت کے معنی و مفہوم کو بیان کر سکے
- ☆ اخوت اسلامی کی اہمیت بیان کر سکے
- ☆ اسلام کی اعلیٰ اقدار کو اپنا کر مثالی معاشرہ پیدا کر سکے

نصاب (سال سوئم)	GEN 311	ٹی پی سی
مطالعہ پاکستان		1 0 1
حصہ دوئم		کل وقت: 20 گھنٹے

موضوعات

- ☆ قیام پاکستان
- ☆ باؤنڈری کمیشن
- ☆ ریڈ کلف ایوارڈ
- ☆ تقسیم بنگال و کلکتہ
- ☆ تقسیم پنجاب
- ☆ مسئلہ مہاجرین
- ☆ ریاست کا الحاق
- ☆ ریاست جموں و کشمیر
- ☆ نہری پانی کا تنازعہ
- ☆ قرارداد مقاصد
- ☆ علماء کے بائیس نکات
- ☆ 1956-1962 اور 1973 کے دساتیر کی اسلامی دفعات
- ☆ پاکستان کا محل وقوع اور اس کی جغرافیائی اہمیت
- ☆ قدرتی وسائل (تیل۔ گیس۔ کوئلہ)

مطالعہ پاکستان (حصہ دوئم)

قیام پاکستان

تدریس مقاصد

عمومی مقاصد: قیام پاکستان کے بعد درپیش مسائل سے آگاہی حاصل کرے اور بیان کرے

☆ خصوصی مقصد:

☆ باؤنڈری کمیشن تشکیل اور اس کے فرائض بیان کر سکے

☆ ریڈ کلف اور اس کے ایوارڈ کے بارے میں بیان کر سکے

☆ بنگال اور کلکتہ کی تقسیم کی وجوہات بیان کر سکے

☆ پنجاب کی تقسیم کی تفصیل بیان کر سکے

☆ مہاجرین کی آمد سے جو مسائل پیدا ہوئے انہیں بیان کر سکے

☆ ریاستوں کے الحاق کے بارہ میں تفصیل بیان کر سکے

☆ ریاست جموں کشمیر کے بارے میں بیان کر سکے

☆ نہری پانی کے تنازعہ کو بیان کر سکے

☆ قرار داد مقاصد کی تفصیلات بیان کر سکے

☆ 22 علماء کے متفقہ اسلامی نکات بیان کر سکے

☆ قیام پاکستان کے بعد نفاذ اسلام کی کوششوں کو بیان کر سکے

☆ پاکستان کے محل وقوع اور اس کی جغرافیائی اہمیت بیان کر سکے

☆ پاکستان میں قدرتی وسائل (تیل۔ گیس۔ کوئلہ) کے بارہ میں بیان کر سکے

(غیر مسلم طلباء کے لئے)

ٹی	پی	سی
1	0	1

کل وقت: 20

Gen 311

نصاب اخلاقیات

سال سوئم

موضوعات

- ☆ احساس ذمہ داری
- ☆ مثبت ذہن
- ☆ عدل و انصاف
- ☆ قومی خدمت کا جذبہ
- ☆ ذکر و نظر کی پاکیزگی
- ☆ احترام آدمیت
- ☆ شائستگی
- ☆ عفو و درگزر
- ☆ بردباری
- ☆ خود انحصاری
- ☆ اثر و نفوذ
- ☆ جامعیت
- ☆ اپنی ذات کی معرفت (بذریعہ ہم عمر طلباء۔ اساتذہ۔ اہم شخصیات اوارہ)

(غیر مسلم طلباء کے لئے)

نصاب اخلاقیات

سال سوئم

تدریس مقاصد

عمومی مقصد: ملکی ترقی کے لیئے اعلی اوصاف کے ساتھ بہتر طور پر ملک و ملت کی خدمت کر سکے

خصوصی مقاصد: طالب علم اس قابل ہو گا کہ

- ☆ موضوعات کا مطلب بیان کر سکے
- ☆ عملی زندگی سے مثالوں کی نشاندہی کر سکے
- ☆ موضوعات کی اہمیت بیان کر سکے
- ☆ اپنی شخصیت اور معاشرے پر موضوعات کے مطابق اثرات پیدا کرنے کے طریقے بیان کر سکے
- ☆ مثبت ذہن کے ساتھ کام کر سکے
- ☆ عدل و انصاف سے ادارہ میں' دفتر میں بہتر ماحول پیدا کر سکے
- ☆ ماحول کو اخلاقی طور پر پاکیزہ بنائے
- ☆ کارکنوں کی بہتر طور پر دل جوئی کر سکے
- ☆ کارکردگی میں اضافہ کر سکے
- ☆ باہمی احترام کی برکات سے استفادہ کر سکے

MGM-321: BUSINESS COMMUNICATION

T	P	C
1	0	1

Total contact hours:

Theory	32
Practical	0

Pre-requisite: The students shall already be familiar with the language concerned.

AIMS:

The course has been designed to enable the students to.

1. Develop communication skills.
2. Understand basic principles of good and effective business writing in commercial and industrial fields.
3. Develop knowledge and skill to write technical report with confidence and accuracy.

COURSE CONTENTS

1. COMMUNICATION PROCESS 6 Hours

- 1.1 Purposes of communication.
- 1.2 Communication process.
- 1.3 Distortions in communication.
- 1.4 Consolidation of communiqué.
- 1.5 Communication flow.
- 1.6 Communication of self-development.

2. COMMUNICATION SKILLS 6 Hours

- 2.1 Significance of speaking.
- 2.2 Verbal and non-verbal messages.
- 2.3 Strategic steps of speaking.
- 2.4 ChaRACTeristics of effective oral messages.
- 2.5 Communication trafficking.
- 2.6 Oral presentation.

3. QUESTIONING SKILLS 3 Hours

- 3.1 Nature of question.
- 3.2 Types of questions.
- 3.3 Characteristics of a good question.
- 3.4 Questioning strategy.

4. LISTENING SKILLS 5 Hours

- 4.1 Principles of active listening.
- 4.2 Skills of active listening.
- 4.3 Barriers to listening.
- 4.4 Reasons of poor listening.
- 4.5 Giving feedback.

5. INTERVIEWING SKILLS 3 Hours

- 5.1 Significance of interviews.
- 5.2 Characteristics of interviews.

5.3 Activities in an interviewing situation.
5.4 Types of interviews.
5.5 Interviewing strategy.

6. REPORT WRITING 3 Hours

6.1 Goals of report writing.
6.2 Report format.
6.3 Types of reports.
6.4 Report writing strategy.

7. READING COMPREHENSION 2 Hours

7.6 Reading problems.
7.7 Four reading skills.

8. GROUP COMMUNICATION 4 Hours

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

BOOKS RECOMMENDED

1. Sh. Ata-ur-Rehman, Effective Business Communication and Report Writing.
2. Ulman J. N. Cloud JR. Technical Reporting.

MGM-321: BUSINESS COMMUNICATION

INSTRUCTIONAL OBJECTIVES

On completion of this course, the students will be able to;

1. UNDERSTAND THE COMMUNICATION PROCESS

1.1 State the benefits of two way of communication.
1.2 Describe a model of communication process.
1.3 Explain the major communication methods used in organizations.
1.4 Identify the barriers to communication and methods to overcome these barriers.
1.5 Identify misconceptions about communication.

2. UNDERSTAND THE PROCESS OF ORAL

2.1 Identify speaking situations with other people.
2.2 Identify the strategic steps of speaking.
2.3 Identify the characteristics of effective oral messages.
2.4 State the principles of one-way communication.
2.5 State the principles of two-way communication.
2.6 Identify the elements of oral presentation skills.
2.7 Determine the impact of non-verbal communication on oral communication.

3. DETERMINE THE USES OF QUESTIONING SKILLS TO GATHER AND CLARIFY INFORMATION IN THE ORAL COMMUNICATION PROCESS

3.1 Identify different types of questions.
3.2 Determine the purpose of each type of question and its application.
3.3 Identify the hazards to be avoided when asking questions.
3.4 Demonstrate questioning skills.

4. DEMONSTRATE THE USE OF ACTIVE LISTENING SKILLS IN THE ORAL COMMUNICATION PROCESS

4.1 State the principles of active listening.
4.2 Identify skills of active listening.
4.3 Identify barriers to active listening.
4.4 State the benefits of active listening.
4.5 Demonstrate listening skills.
4.6 Explain the importance of giving and receiving feedback.

5. DETERMINE THE APPROPRIATE INTERVIEW TYPE FOR THE SPECIFIC WORK-RELATED SITUATION AND CONDUCT A WORK-RELATED INTERVIEW

5.1 State the significance of interviews.
5.2 State the characteristics of interviews.
5.3 Explain the activities in an interviewing situation.
5.4 Describe the types of interviews.
5.5 Explain the interviewing strategy.
5.6 Prepare instrument for a structured interview.

6. PREPARE A REPORT OUTLINE BASED ON SUBJECT MATTER AND AUDIENCE

6.1 Identify the different types of reports.
6.2 Determine when to use an informal or formal report presentation.
6.3 Identify the stages of planning a report.
6.4 Identify the parts of a report and chose the parts appropriate for each type of report.
6.5 Draft a report outline.

7. DEMONSTRATE READING COMPREHENSION

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

8. UNDERSTAND THE PRINCIPLES OF GROUP COMMUNICATION

8.1 State the purposes and characteristics of major types of meetings.
8.2 Explain responsibilities of a meeting/committee.
8.3 Identify problems likely to be faced at meeting and means to overcome these problems.
8.4 Distinguish between content and process at meetings.
8.5 Explain the key characteristics of a good group facilitator.

MGM-322: INDUSTRIAL MANAGEMENT AND HUMAN RESOURCE DEVELOPMENT

T	P	C
2	0	2

Total Contact Hours:

Theory : 64
Practical: 00

Pre-Requisites:

1. General understanding of management and economics activities.
2. Ability to go through the study material.
3. Active mind.
4. Motivation.

AIMS:

1. To develop the management skill of the subject.
2. To acquaint the learner with the principles of management and human relations.
3. To develop psychological approach to solve the labour problems in the industrial set-up.

COURSE CONTENTS

1. INDUSTRIAL PSYCHOLOGY 2 Hours

- 1.1 Introduction to management.
- 1.2 Brief history of industrial psychology.
- 1.3 Definition of psychology.
- 1.4 Nature and scope of psychology.

2. LEADERSHIP 2 Hours

- 2.1 Definition.
- 2.2 Types.
- 2.3 Qualities of a good leader.

3. MOTIVATION 3 Hours

- 3.1 Definition.
- 3.2 Types. (Financial and non-financial motives)
- 3.3 Conflict of motives.

4. MORALE 2 Hours

- 4.1 Importance.
- 4.2 Development.
- 4.3 Measurement.

5. HUMAN ENGINEERING 2 Hours

- 5.1 Importance of human factor in industry.
- 5.2 Man-machine system.
- 5.3 Strategy for making allocation decisions.

6. INDUSTRIAL FATIGUE AND BOREDOM 3 Hours

6.1 Definition and distinction.
6.2 Psychological causes.
6.3 Objectives causes.
6.4 Preventions.

7. INDUSTRIAL ACCIDENTS 3 Hours

7.1 Psychological causes.
7.2 Objective causes.
7.3 Preventions.

8. INDUSTRIAL PREJUDICE 2 Hours

8.1 Causes.
8.2 Remedies.

9. PUBLIC RELATION 2 Hours

9.1 Importance.
9.2 Functions.

10. GUIDANCE AND COUNSELLING 3 Hours

10.1 Importance.
10.2 Choice of job.
10.3 During service.

11. JOB EVALUATION 3 Hours

11.1 Importance.
11.2 Methods.
11.3 Job satisfaction.
11.4 Work simplification.

12. WORK APPRAISAL 2 Hours

12.1 Importance.
12.2 Techniques.

13. INDUSTRIAL MANAGEMENT 3 Hours

13.1 Introduction.
13.2 Functions of Management.
13.3 Subdivision of Management.
13.4 Objectives of Industrial Management.

14. PLANNING 3 Hours

14.1 The concept.
14.2 Importance of planning.
14.3 Steps in planning.
14.4 Principles of planning.

15. PLANT LOCATION AND LAYOUT 4 Hours

15.1 Plant location.
15.2 Selection of plant location.
15.3 Types of factory building.

15.4 Plant layout.
15.5 Factors affecting it.
15.6 Process and product layout.
15.7 Plant location and layout of a factory/printing press.

16. PERSONNEL SELECTION 2 Hours

16.1 Recruitment of employees
16.2 Training.
16.3 Effects of training on production and product cost.

17. WAGE PAYMENT PLANS 3 Hours

17.1 Importance.
17.2 Principles.
17.3 Important plans.
17.4 Effects on production cost.

18. TYPES OF PRODUCTION 2 Hours

18.1 Job, batch, flow and mass production.
18.2 Types of production and cost considerations.

19. WORKING CONDITIONS 3 Hours

19.1 Importance.
19.2 Consideration.
19.3 Effects on efficiency and per unit cost.

20. TIME AND MOTION STUDY 3 Hours

20.1 The concept.
20.2 Importance of work study for management.
20.3 Sequence of motion study.
20.4 Steps to time study.
20.5 Determination of operations time.

21. QUALITY CONTROL 2 Hours

21.1 The concept.
21.2 Advantages of quality control.
21.3 Methods.

22. ROLE OF FOREMAN IN MANAGEMENT 2 Hours

22.1 Foreman's abilities.
22.2 Duties.
22.3 Functions.

23. FOREMAN'S KNOWLEDGE OF COST ACCOUNTING 3 Hours

23.1 Concept of cost accounting.
23.2 Elements of cost.
23.3 Cost accounting methods.

24. PRODUCTIVITY 2 Hours

24.1 The concept.

24.2 Importance.
24.3 Factors affecting productivity.

25. ISO-9000 3 Hours

25.1 Concept of ISO-9000
25.2 Quality policy of products
25.3 Pre-requisites for ISO-9000
25.4 Organization chart and standard operation procedures.
25.5 Pre-accreditation audit.
25.6 ISO-9000 certificate accreditation.

BOOKS RECOMMENDED

1. Industrial Psychology, C. S. Meyers, Oxford University Press, London.
2. Psychology of Industrial Behaviours, Smith Wakley, McGraw Hill Book Co.
3. Nizamat-e-Sanaat Aur Insani Rawabat, Ghulam Hussain, Ilmi Kitab Khana, Urdu Bazar, Lahore.
4. The Process of Management, Andrew R. Megill, William M. Newman.
5. Management of Industrial Enterprises, Richard N. Omen.
6. Factory and Production Management, K.G. Lockyer.

MGM-322: INDUSTRIAL MANAGEMENT AND HUMAN RESOURCE DEVELOPMENT

INSTRUCTIONAL OBJECTIVES

On completion of this course, the students will be able to;

1. UNDERSTAND THE INDUSTRIAL PSYCHOLOGY
- 1.1 Explain introduction to management
- 1.2 Describe brief history of industrial psychology.
- 1.3 Describe in detail definition of industrial psychology.
- 1.4 Describe nature and scope of industrial psychology.

2. UNDERSTAND THE LEADERSHIP
- 2.1 Define leadership.
- 2.2 Describe types of leadership.
- 2.3 Describe qualities of a good leader.

3. UNDERSTAND THE MOTIVATION
- 3.1 Define motivation.
- 3.2 Describe financial and non financial motives.
- 3.3 Explain conflict of motives.

4. UNDERSTAND THE MORALE
- 4.1 Describe importance of morale.
- 4.2 Describe development of morale.
- 4.3 Describe measurement of morale.

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

6. UNDERSTAND THE INDUSTRIAL FATIGUE AND BOREDOM
- 6.1 Describe psychological causes of fatigue and boredom.
- 6.2 Describe objective causes of fatigue and boredom.
- 6.3 Describe preventive measures of fatigue and boredom.

7. UNDERSTAND THE INDUSTRIAL ACCIDENTS
- 7.1 Explain psychological causes of industrial accidents.
- 7.2 Explain objective causes of industrial accidents.
- 7.3 Explain preventive measures of industrial accidents.

8. UNDERSTAND THE INDUSTRIAL PREJUDICE
- 8.1 Explain causes of industrial prejudice.
- 8.2 Explain remedies of industrial prejudice.

9. UNDERSTAND THE PUBLIC RELATIONS
- 9.1 Explain importance of public relations.
- 9.2 Explain functions of public relations.

10. UNDERSTAND THE GUIDANCE AND COUNSELLING

10.1 Describe importance of guidance and counselling.
10.2 Describe help of guidance and counselling in choosing the job.
10.3 Describe help of guidance and counselling during service.

11. UNDERSTAND THE JOB EVALUATION

11.1 Explain importance of job evaluation.
11.2 Explain methods of job evaluation.
11.3 Explain job satisfaction.
11.4 Explain work simplification.

12. UNDERSTAND THE WORK APPRAISAL

12.1 Explain importance of work appraisal.
12.2 Explain work appraisal techniques.
12.3 Industrial Management and HR/HRD.

13. UNDERSTAND THE INDUSTRIAL MANAGEMENT

13.1 Explain management.
13.2 Describe functions of management.
13.3 Enlist subdivision of management.
13.4 Explain objectives of industrial management.

14. UNDERSTAND THE PLANNING

14.1 State planning.
14.2 Describe the importance of planning.
14.3 Identify the steps in planning.
14.4 Enlist principles of planning.

15. UNDERSTAND THE PLANT LOCATION/LAYOUT

15.1 State plant location.
15.2 Explain selection of plant location.
15.3 Describe types of building.
15.4 State plant layout.
15.5 Explain factors affecting layout.
15.6 Describe process and product layout.
15.7 Explain plant location and layout of an ideal printing press.

16. UNDERSTAND TRAINING AND ITS EFFECTS

16.1 Describe the recruitment procedure of employees in an industrial concern.
16.2 Explain training.
16.3 Identify the kinds of training.
16.4 State the effects of training on production and product cost.

17. KNOW WAGE IN CENTIME SCHEMES

17.1 Explain importance of wage payment plans.
17.2 Identify the principles of wage payment plan.
17.3 Describe briefly standard time plan, straight piece rate, differential piece rates.
17.4 State the effects on incentive plans on total cost and labour cost.

18. KNOW TYPES OF PRODUCTION ALONGWITH THEIR IMPACTS ON COST

18.1 Describe types of production.
18.2 State the effects of production types on cost.

19. UNDERSTAND WORKING CONDITION ALONGWITH EFFECTS ON EFFICIENCY

19.1 Explain importance of working condition.
19.2 Describe consideration, i.e., air-conditioning ventilation, lighting and noise.
19.3 State the effects of good working condition on efficiency and per unit cost.

20. KNOW ABOUT TIME AND MOTION STUDY

20.1 Explain the concept.
20.2 Describe the importance of work study.
20.3 Explain the sequence of motion study.
20.4 Identify the principles of motion study.
20.5 Describe the steps of time study.
20.6 Explain the determination of operations time.

21. UNDERSTAND THE QUALITY CONTROL

21.1 Explain quality control.
21.2 Identify the advantages of quality control.
21.3 Describe methods of quality control.

22. UNDERSTAND THE ROLE OF FORMING IN AN INDUSTRIAL UNDERTAKING

22.1 Explain ability of the foreman.
22.2 Indentify duties of forming.
22.3 Describe functions of foreman as middle management.

23. KNOW FOREMAN'S KNOWLEDGE OF COST ACCOUNTING

23.1 Explain concept of cost accounting.
23.2 Explain elements of cost.
23.3 Identify the cost accounting.

24. UNDERSTAND PRODUCTIVITY METHODS

24.1 Explain the concept.
24.2 Describe importance of productivity.
24.3 State the factors affecting productivity.

25. UNDERSTAND ISO-9000

25.1 Describe the concept of ISO-9000.
25.2 Explain quality policy of products.
25.3 Enlist and state pre-requisites for ISO-9000.
25.4 Identify organization chart and standard operating procedures.
25.5 Illustrate the need of pre accreditation audit.
25.6 Explain the advantage of ISO-9000 certificate accreditation.

ELR – 311 **BASIC ELECTRONICS APPLIED TO HVAC&R SYSTEMS**

T	P	C
0	3	1

Total contact hours:

Practical 96 hours

AIM: At the end of the course, the students will be able to:-
Understand the basic principles of electronics/electronic controls (components)

LIST OF PRACTICALS

On completion of this course the students will be able to;

1. Define the terminology's used in electronics.
2. Define diode and make a circuit using diode as a rectifier.
3. State transistor and make a circuit using transistor as an amplifier in CE configuration.
4. Explain the working of Silicon Controlled Rectifier (SCR) and make circuit by using SCR to control the D.C. motor speed (D.C. power).
5. Describe the working of Diac and Triac. Make circuits by using Diac & Triac. to control AC power.
6. Explain the working of controlled transformer. Study the working by connecting a control transformer into a circuit.
7. Explain the working of Uni. Junction Transistor (UJT) in time delay (relay) circuit. Study and Practice that how it is connected in the in time delay (relay) circuit.
8. Define the uses of thermocouple as temperature control device. Perform tests using thermocouple as temperature control device for open and close circuits to verify the out put.
9. Describe the use of thermistor as a temperature sensing device. By using it measure the temperatures of various surfaces.
10. Explain the purpose of opto-coupler. By using it make the circuits of;
    (a) Illumination control (Photo Cell)
    (b) Counter
    (c) Pin-hole detector
    (d) Flame failure control
11. Explain the working of DC time delay relay. Connect it in actual circuit and observe its working.
12. Describe the working of sequence timer. Connect it in actual circuit and observe its working.
13. Explain the working of AC resistance sensitive relay. Connect it in actual circuit and observe its working.
14. Describe the working of heat sensitive relay. Connect it in actual circuit and observe its working.
15. Explain the working of an electro-pneumatic controller. Connect it in actual circuit and observe its working.
16. Describe the working of an electro-mechanical controller. Connect it in actual circuit and observe its working.

HVAC-315: AIR -CONDITIONING SYSTEM DESIGN

T	P	C
4	3	5

Total contact hours:

Theory: 128 hours
Practical: 96 hours

Prerequisites:

1. Principles of Refrigeration & Air conditioning.

All core Technology subjects studied in 2nd year.

AIM: At the end of the course, the students will be able to:

1. Design the HVAC&R Systems of all classes of buildings, including load estimation, sizing the ducts, pipes, air-handling equipment and selection of unit.
2. Understand the process of air conditioning of buildings like libraries, clean spaces, computer rooms, data centers, process industry, healthcare facilities, laboratories, pharmaceutical industry, food technology etc.

COURSE CONTENTS

1. SCOPE AND USE OF PROCESS AIR CONDITIONING SYSTEM 6 Hours

1.1 Scope of Air-conditioning
1.2 Indoor Air Quality (IAQ) / Indoor Environmental Quality (IEQ)
1.3 Components of Air conditioning system.
1.4 All water (Hydronic) Air conditioning systems.
1.5 All air type air conditioning system.
1.6 Planning, installing, startup, commissioning and operating the HVAC&R system.

2. SELECTION OF DESIGN CONDITIONS 5 Hours

2.1 Winter Inside & Outside Design Conditions
2.2. Summer Inside & Outside Design Conditions

3. HEAT STORAGE, DIVERSITY AND STRATIFICATION 5 Hours

3.1 Building Orientation
3.2 Storage of heat in building structure.
3.3 Diversity of cooling load.
3.4 Stratification of heat.
3.5 Building transmission losses.
3.6 Thermal storage in building structure.

4. COOLING & HEATING LOAD CALCULATION FOR BUILDINGS 24 Hours

4.1 External Weather Dependant Heat Gain/Loss
- 4.1.1 Heat storage effect.
- 4.1.2 Room heat gain
- 4.1.3 Conduction through exterior structure.
- 4.1.4 Conduction through interior structure.
- 4.1.5 Diffused or sky radiation.

4.1.6 Direct radiation.
4.1.7 Solar radiation through glass.
4.1.8 Shading device.
4.1.9 Structural shading.
4.1.10 Solar transmission through wall and roofs.

4.2 Internal heat gain.
4.2.1 Occupancy Load
4.2.2 Lighting Load
4.2.3 Equipment Load
4.2.5 Duct Heat Gain & Leakage
4.2.6 Fan & Pump Heat

4.3 Problem solving

5. VENTILATION LOAD 8 Hours

5.1 Ventilation Load
5.2 Infiltration load.
5.3 Exfilteration load.
5.3 Temperature swing.
5.4 Summary of commercial cooling & heating load calculations

6. HYDRONIC PIPING SYSTEM. 22 Hours

6.1 Piping arrangement.
6.2 Series loop
6.3 One pipe main
6.4 Two pipe direct return.
6.5 Two-pipe reverse return.
6.6 Combination arrangement.
6.7 Three pipe system
6.8 Four pipe system
6.9 Calculation of pipe sizing
6.9.1 Frictional Loss from Water Flow in Pipes
6.9.2 Frictional Loss in Open / Close Systems
6.9.3 Pressure Loss in Pipe Fittings
6.9.4 Pressure Drop in Piping System
6.9.5 System Pipe Sizing
6.10 Problem Solving

7. AIR HANDLING UNIT/TERMINAL UNIT. 10 Hours

7.1 Types of terminal units (Heating).
7.2 Radiators.
7.3 Convectors.
7.4 Base board
7.5 Radiant panel
7.6 Propeller fan type unit heaters.
7.7 Cabinet unit heaters.
7.8 Chilled Beams
7.9 Fan coil units.
7.10 Induction unit (Heating & Cooling)
7.11 Method of selecting terminal unit.

8. METHODS OF DUCT DESIGNING. 10 Hours

8.1 Equal friction method.
8.2 Velocity reduction method.
8.3 Static regain method.
8.4 Single and dual duct system.
8.5 Noise attenuation in ducts.
8.6 Calculations on duct sizes.

9. SOLAR HEATING AND COOLING SYSTEM 6 Hours

9.1 Solar collectors.
9.2 Storage and distribution system.
9.3 Types of solar heating system
9.4 Solar cooling system
9.5 Sunshine hours.
9.6 Collector performance.

10. AIR CONDITIONING SYSTEM. 10 Hours

10.1 System classification and their basic controls.
10.2 All air system.
10.3 Single zone system
10.4 Reheat system.
10.5 Multizone system.
10.6 Dual duct system.
10.7 Variable air volume system.
10.8 Airflow requirement (measured in CFM or m^3/min)

11. AIR CONDITIONING SYSTEM OF COMMERCIAL BUILDINGS 16 Hours

11.1 Laboratories (Chemical & Biological)
11.2 Computer Room/Data Centers/Studios.
11.3 Printing Press
11.4 Clean Spaces/Class Rooms/Residences
11.5 Libraries & Museums
11.6 Textile and other Industries.
11.7 Healthcare Facilities (Hospitals etc.)
11.8 Pharmaceutical Labs
11.9 Food Technology
11.10 Process Industry
11.11 Hotels & Restaurants

12. COSTING & ESTIMATION **04 Hours**

12.1 Project Specifications
12.2 Bill of Quantity (BOQ) / Bill of Material (BOM)
12.3 Schedule of Prices
12.4 Risk Factors & Contingency Margins
12.5 Overhead Expenses
12.6 Project Completion Time

13. GREEN BUILDINGS CONCEPT 02 Hours

13.1 Overview
13.2 Building Rating Systems
13.3 Accreditation Agencies such as US Green Building Council (USGBC) Leeds
13.4 Energy Efficient Design of Buildings & Zero Energy Buildings

RECOMMENDED BOOK

1. Air conditioning Principle and System by E.G.Pita.
2. Principle of Refrigeration by R.J. Dossat.
3. System Design Manual by Carrier
4. ASHRAE – Fundamental 2005
5. Manufacturing Equipment catalogues by Trane or Carrier Company
6. Refrigeration and Air conditioning (A text book) by R.S. Khurmi, and J.K. Gupta.
7. Green Buildings by ASHRAE
8. Manual prepared by National Institute of Science & Technology (NISTE), Ministry of Education, Government of Pakistan, Islamabad
9. Helpful Software for Air Conditioning System Design:
   - Hourly Analysis Program (HAP)
   - Trace by Trane
   - Elite
   - ASHRAE Duct Fitting Database

HVAC-315: AIR-CONDITIONING SYSTEM DESIGN

INSTRUCTIONAL OBJECTIVES

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

1. UNDERSTAND THE SCOPE AND USE OF AIR-CONDITIONING SYSTEM

- 1.1 State the scope of air-conditioning in modern age.
- 1.2 Describe Indoor Air Quality (IAQ) / Indoor Environmental Quality (IEQ)
- 1.3 Describe components of Air Conditioning System
  - 1.3.1 Source
  - 1.3.2 Air-distribution system.
  - 1.3.3 Equipment for moving the air or water.
- 1.4 Explain all water (hydronic) air-conditioning system.
- 1.5 Explain all air type air-conditioning system.
- 1.6 Explain planning, installing, startup, commissioning and operating the HVAC&R system.

2. UNDERSTAND THE PROCEDURE OF SELECTING THE OUTSIDE DESIGN CONDITIONS IN WINTER AND SUMMER.

- 2.1 Describe Winter Inside & Outside Design Conditions
- 2.2. Describe Summer Inside & Outside Design Conditions

3. UNDERSTAND THE HEAT STORAGE EFFECT, DIVERSITY AND STRATIFICATION.

- 3.1 Describe building orientation
- 3.2 Describe the storage of heat in building structure.
- 3.3 State the diversity of cooling load.
- 3.4 Define stratification.
- 3.5 State building transmission losses.
- 3.6 Explain thermal storage in a building structure.

4. UNDERSTAND THE PRINCIPLES OF REFRIGERATION AND AIR CONDITIONING LOAD ANALYSIS

- 4.1 Calculate cooling & heating load with basic equations in heat exchange components.
- 4.2 Identify different load factor in air-conditioning system.
- 4.3 Calculate room heat gain / loss
- 4.4 Calculate conduction through exterior & interior structure.
- 4.5 Define sky or diffused radiation.
- 4.6 Define direct solar radiation.
- 4.7 Describe solar radiation through glass.
- 4.8 Describe the effect of shading devices, for calculating cooling load or heating load.
- 4.9 Enlist the method of calculating conduction heat gain through wall and roofs due to solar transmission.
- 4.10 Derive the formula for calculating internal heat gain/loss.
- 4.11 Calculate the heat gain from occupancy Load
- 4.12 Calculate the heat gain from Lighting Load

4.13 Calculate the heat gain from Equipment Load
4.14 Describe Duct Heat Gain & Leakage (Ventilation Load)
4.15 Describe Fan and Pump Heat (Ventilation Load)
4.16 Problem Solving

5 UNDERSTAND TO CALCULATE THE VENTILATION LOAD OF DIFFERENT TYPES OF BUILDINGS.

5.1 Define infiltration.
5.2 Define exfilteration.
5.3 Define temperature swing.
5.4 Explain the method of commercial cooling load calculation.
5.5 Calculate commercial cooling loads

6. UNDERSTAND THE HYDRONIC / PIPING SYSTEM.

6.1 Define the term hydronic system.
6.2 Enlist the method of piping arrangement.
6.3 State series loop system.
6.4 State one pipe system.
6.5 State two pipe direct return.
6.6 State two pipe reverse return.
6.7 Explain combination arrangement with the help of drawing.
6.8 Explain three and four pipe system.
6.9 Calculation of pipe sizing
  6.9.1 Describe Frictional Loss from Water Flow in Pipes
  6.9.2 Describe Frictional Loss in Open / Close Systems
  6.9.3 Describe Pressure Loss in Pipe Fittings
  6.9.4 Describe Pressure Drop in Piping System
  6.9.5 Calculate System Pipe Sizing
6.10 Problem Solving

7. UNDERSTAND THE FUNCTION OF AIR HANDLING UNITS AND TERMINAL UNITS.

7.1 State the function of air-handling units.
7.2 Enlist the types of terminal units.
7.3 Explain the function of radiators.
7.4 Explain the function of convectors.
7.5 Explain the function of base board.
7.6 Explain the function of radiant panel.
7.7 Explain the function of propeller type unit heaters.
7.8 Explain the function of cabinet unit heater.
7.9 Explain the function of Chilled Beams
7.10 Explain the function of fan coil units.
7.11 Explain the function of induction unit.
7.12 Explain the method of selecting terminal unit.

8. METHODS OF DUCT DESIGNING.

8.1 Explain Equal friction method.

8.2 Explain Velocity reduction method.
8.3 Explain Static regain method.
8.4 Explain Single and dual duct system.
8.5 Explain Noise attenuation in ducts.
8.6 Explain Calculations on duct sizes.

9. UNDERSTAND THE SOLAR HEATING AND COOLING SYSTEMS.

9.1 Define solar heating and cooling system.
9.2 Describe solar collectors.
9.3 State storage and distribution system.
9.4 Enlist the types of solar heating system.
9.5 Explain solar cooling system.
9.6 State solar radiation energy.
9.7 Calculate the collector performance.
9.8 Explain sunshine hours.
9.9 Describe the method of sizing of collectors.

10. UNDERSTAND THE AIR-CONDITIONING SYSTEMS.

10.1 Enlist the different types of air-conditioning system.
10.2 Define basic controls used in A/C Systems.
10.3 Describe all air system.
10.4 Describe single zone system.
10.5 Explain reheat system.
10.6 Explain single zone system.
10.7 Explain multizone and duel duct system.
10.8 Explain variable air volume (VAV) system.
10.9 Explain all water and air water system.
10.10 Describe unitary versus central system.
10.11 Explain the methods used to determine Air Flow (CFM or m^3/min required)

11. UNDERSTAND AIR CONDITIONING SYSTEMS OF DIFFERENT TYPE OF COMMERCIAL/INDUSTRIAL BUILDINGS

Explain planning & designing of Air Conditioning System For:

11.1 Laboratories (Chemical & Biological)
11.2 Computer Room/Data Centers/Studios.
11.3 Printing Press
11.4 Clean Spaces/Class Rooms/Residences
11.5 Libraries & Museums
11.6 Textile and other Industries.
11.7 Healthcare Facilities (Hospitals etc.)
11.8 Pharmaceutical Labs
11.9 Food Technology
11.10 Process Industry
11.11 Hotels & Restaurants

12. COSTING & ESTIMATION

12.1 Understanding & Importance Project Specifications
12.2 Preparing Bill of Quantity (BOQ) / Bill of Material (BOM)

12.3 Describe Schedule of Prices
12.4 Describe Risk Factors & Contingency Margins
12.5 Describe Overhead Expenses
12.6 Estimating Project Completion Time

13. GREEN BUILDINGS CONCEPT

13.1 Give Introduction of Green Buildings
13.2 Explain Building Rating Systems and describe different international building rating systems for green buildings
13.3 Describe the role of Accreditation Process and Accreditation Agencies such as US Green Building Council (USGBC) Leeds
13.4 Describe Energy Efficient Design of Buildings and Zero Energy Buildings

HVAC-315: AIR-CONDITIONING SYSTEM DESIGN

LIST OF PRACTICALS 96 Hours

On completion of this course the trainees will be able to;

1. Practice of data take off from Architectural Drawings
2. Practice of problem solving on heat load and cooling load.
3. Visit of a air conditioning plant to study its components.
4. Practice of problem solving on ventilation load.
5. Visit to various installations of commercial air conditioning system plants.

    a. Reciprocating, vapour compression system (Air & Water Cooled)

    b. Centrifugal vapour compression system

    c. Absorption system:

        i. Hot water fired absorption system.
        ii. Steam fired absorption system
        iii. Direct fired absorption system

6. Preparation of visit report consisting on the function of different components. Enlisting the type of refrigerant and its percentage used. Temperature control devices used. Types of air handling units, fan coil units, and terminal units used etc.
7. Practice on the servicing and maintenance of AC units/plants during summer vacations.
8. Technical Projects

- Design and Equipment Selection of Central Air-conditioning for High rise multistory Commercial Building
- Design and Equipment Selection of Central Air-conditioning for Departmental Store.
- Design and Equipment Selection of Central Air-conditioning for Computer Room/Testing Laboratories/Clean Spaces.
- Design and Equipment Selection of Central Air-conditioning for Industrial Building:

    - Electronic Manufacturing Company
    - Textile Mill

- Design and Equipment Selection of Central Air-conditioning for Cinema House
- Design and Equipment Selection of Central Air-conditioning for Healthcare Facility.
- Design and Equipment Selection of Central Air-conditioning for Hotel/ Cafeteria.
- Design and Equipment Selection of Plant for Data Center
- Design and Equipment Selection of Plant for Laboratories (Chemical / Biological)
- Design and Equipment Selection of Plant for Pharmaceutical
- Design and Equipment Selection of Plant for Process Industry
- Design and Equipment Selection of Plant for Food technology
- Design and Equipment Selection of Plant for Libraries & Museum

Note: (i) The projects are to be divided amongst the group of students. At least two projects be assigned to each group for evaluation.

(ii) Project Report should contain the following information as given below:

1. Cover.
2. Title page.
3. Statement of project.
4. Building tracing/drawing.
5. Design criteria.
6. Heating and cooling load calculations using any recommended software
7. Ventilation requirements.
8. Preliminary layout (Location of equipment , piping and duct work etc.)
9. Distribution system calculations.

    a. Duct sizing.
    b. Pipe sizing.

10. Psychrometric charts of system operation.
11. Equipment selection calculations.

    a. Air Handling units.
    b. Cooling and heating coils.
    c. Circulating pumps.
    d. Register.
    e. Grills.
    f. Diffusers.
    g. Boilers
    h. Chillers.
    i. Cooling towers.
    j. Filters
    k. Pumps
    l. Fans
    m. VAV / CAV
    n. Humidifiers (if requires)
    o. Control valves.
    p. Thermostats.

12. Schematic control system.
13. Working drawings including all necessary details.
14. List of material.

Project will be evaluated on correct application of engineering principles, appropriation of system and equipment selected for the problem, organization and presentation of the report.

HVAC-322: WATER AND AIR DISTRIBUTION

T	P	C
2	0	2

Total Contact Hours

Theory 64 hours

Prerequisites.

1. Fundamentals of Basic Sciences.
2. Fundamentals of Math.
3. Principles of air conditioning.

AIM: At the end of the course, the students will be able to:

(i) Understand water treatment, cooling towers, chilled/hot water piping system.
(ii) Understand, the basic theory of fluid flow, static velocity and friction head.
(iii) Understand the water pumps, Fans, water and air filtration/purification and treatment.

1. CONDENSERS, CONDENSER LOAD & COOLING TOWER **10** Hours

1.1 Condenser capacity.
1.2 Function of condenser.
1.3 Calculate condenser capacity.
1.4 Quantity and temperature rise of condenser media (air and water).
1.5 Air cooled condenser, air quantity and velocity.
1.6 Water cooled condenser, water quantity and velocity..
1.7 Rating and selection of air and water cooled condensers.
1.8 Evaporative condensers
1.9 **Cooling Towers**.
1.10 Types of Cooling Towers.
1.11 Cooling Tower Design.
1.12 Rating and Selection of cooling towers.
1.13 Problem Solving

2. FUNDAMENTALS OF WATER TREATMENT. 3 Hours

2.1 Water analysis before water treatment
2.2 Impurities.
2.3 Kinds of treatment, screening.
2.4 Sedimentation.
2.5 Coagulation
2.6 Filtration,

3. CHEMICAL TREATMENT OF WATER. 5 Hours

3.1 Aeration and deaeration.
3.2 Distillation and neutralization.
3.3 Organic and in organic control.
3.4 Corrosion and solubility.
3.5 Cycle of concentration.
3.6 Water analysis of treated water

3.7. Chemical by-pass feeders
3.8 Water softeners
3.9 pH controllers
3.10 Conductivity controllers.
3.11 De-ionizers

4. FUNDAMENTALS OF FANS. 10 Hours

4.1 Purpose of fans
4.2 Types of fans.
4.3 Centrifugal fans and axial fans.
4.4 Fan Laws.
4.5 Fan Efficiency and Performance (Centrifugal & Axial Fans)
4.6 Fan velocity and pressure.
4.7 Fan HP and efficiency.
4.8 Fan total pressure.
4.9 Fan static pressure.
4.10 Selection of fan.
4.11 Problem solving.

5. FUNDAMENTALS OF DUCTS DESIGN. 6 Hours

5.1 Conventional low velocity duct design.
5.2 Equivalent rectangular ducts and aspect ratio.
5.3 Dynamic pressure losses.
5.4 Pressure losses in elbows and branches take off.
5.5 Diverging and converging duct sections.
5.6 Changes in duct friction loss with change in air density.

6. FUNDAMENTALS OF PUMPS **10 Hours**

6.1 Purpose of Pumps
6.2 Types of Pumps
6.3 Pump Laws
6.4 Pump Hp and Efficiency
6.5 Pump Head Calculation for Pump Sizing
6.6 Selection of Pumps
6.7 Parallel Pumps & selection method
6.8 Variable Speed Pumping in HVAC&R
6.9 Problem Solving

7. AIR DISTRIBUTION DEVICES. 8 Hours

7.1 Room air distribution.
7.2 Air patterns.
7.3 Location of air distribution devices.
7.4 Air inlet and outlet devices, (Grilles, Diffusers, Registers etc.).
7.5 Applications.
7.6 Selection of air inlet and outlet devices
7.7 Accessories and duct connections.
7.8. VAV terminals.
7.9 Sound and sound control.

8. AIR CLEANING DEVICES (FILTERS) 4 Hours

8.1 Methods of dust removal.
8.2 Methods of testing filters.
8.3 Types of air cleaners.
8.4 Selection of air cleaners.
8.5 Methods of filtering air

9. PIPING, VALVES AND STRAINERS 8 Hours

9.1 Piping materials and specification.
9.2 Fitting and joining methods for steel pipe.
9.3 Fittings and joining methods for copper tubing
9.4 Valves & Types of valves and strainers.
9.5 Selection of valves & strainers
9.6 Pipe insulation.
9.7 Pipe installation.
9.8 Vibration and Expansion control

REFERENCE BOOKS

1. Air Conditioning Principles and System by E.G,Pita.
2. Principles of Refrigeration by R.J. Dossat.
3. Trane Air Conditioning manual
4. Refrigeration, Air conditioning and Cold Storage by Gunther.
5. Principles of Air Conditioning by William Coad, Ronal H. Howell and Harry Sauer (ASHRAE)
6. Manual prepared by National Institute of Science & Technology (NISTE), Ministry of Education, Government of Pakistan, Islamabad

HVAC-322: WATER AND AIR DISTRIBUTION

INSTRUCTIONAL OBJECTIVES:

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

1. UNDERSTAND THE CONDENSERS AND CONDENSER LOAD CALCULATIONS.

1.1 Define condenser.
1.2 Explain the function of condenser.
1.3 Calculate condenser capacity.
1.4 Explain quantity and temperature size of condenser media (air and water).
1.5 Explain air cooled condenser, air quantity and velocity.
1.6 Explain water cooled condenser, water quantity and velocity..
1.7 Explain rating and selection of air and water cooled condensers.
1.8 Explain evaporative condensers.
1.9 Define cooling towers.
1.10 Explain types of cooling towers.
1.11 Explain cooling tower design.
1.12 State rating and selection of cooling towers
1.13 Problem Solving.

2. UNDERSTAND THE FUNDAMENTALS OF WATER TREATMENT.

2.1 State the use and importance of water treatment in air conditioning system.
2.2 Analyze water analysis before water treatment
2.3 Explain impurities of water and types of water treatment.
2.3 Define sedimentation.
2.4 Define coagulation.
2.5 Explain filtration process.

3. UNDERSTAND THE CHEMICAL TREATMENT OF WATER.

3.1 Define aeration and deaeration.
3.2 Distinguish between distillation and neutralization.
3.3 Explain organic and in organic control.
3.4 Define corrosion and solubility.
3.5 Explain cycle of concentration.
3.6 Explain water analysis of treated water
3.7. Explain chemical by-pass feeders
3.8 Explain water softeners
3.9 Explain pH controllers
3.10 Explain conductivity controllers.
3.11 Explain de-ionizers

4. UNDERSTAND THE FUNDAMENTALS OF FANS

4.1 Define the purpose of fans
4.2 Enlist the types of fans.
4.3 Define centrifugal fans and axial fans.
4.4 Describe fan laws.

4.5 State fan efficiency for Centrifugal & Axial Fans .
4.6 Define fan velocity and pressure.
4.7 Define fan HP and efficiency.
4.8 State fan total pressure.
4.9 State fan static pressure.
4.10 State selection of fan.
4.11 Solve problems.

5. UNDERSTAND THE FUNDAMENTALS OF DUCT DESIGN.

5.1 Explain conventional low velocity duct design.
5.2 Describe equivalent rectangular ducts and aspect ratio.
5.3 Calculate dynamic pressure losses in duct elbows and branch take off.
5.4 Calculate the pressure losses in duct elbows and branch take off.
5.5 State diverging and converging duct section.
5.6 Explain the changes in duct friction loss with change in air density.

6. FUNDAMENTALS OF PUMPS

6.1 Describe Purpose of Pumps
6.2 Explain Types of Pumps
6.3 State Pump Laws
6.4 Define Pump Hp and Efficiency
6.5 Calculate Pump Head for Pump Sizing
6.6 Describe Selection of Pumps
6.7 Describe Parallel Pumps & selection method
6.8 Describe Variable Speed Pumping in HVAC&R
6.9 Problem Solving

7. UNDERSTAND THE AIR DISTRIBUTION DEVICES.

7.1 Explain room air distribution.
7.2 Define air patterns.
7.3 Describe location of air distribution devices.
7.4 Explain air inlet and outlet devices, (Grilles, Diffusers, Registers etc.).
7.5 Describe applications of air devices..
7.6 Explain the method of selection of air inlet and outlet devices
7.7 Explain accessories and duct connection.
7.8 State VAV terminals.
7.9 Explain sound and sound control.

8. UNDERSTAND THE AIR CLEANING DEVICES.

8.1 Define the different methods of dust removal.
8.2 Define the method of testing filters.
8.3 State the types of air filter.
8.4 State the types of air cleaner.
8.5 Explain the selection of air cleaners.

9. UNDERSTAND THE PIPING, FITTINGS, VALVES AND STRAINERS

9.1 State the different types of piping material and its specification.
9.2 Enlist the different types of pipe fittings.
9.3 State the method of joining copper tubing and copper fittings.
9.4 State the different types of valves and strainers

9.5 Explain all types of valves according to its working principle.
9.6 Explain the procedure of selecting the valves and strainers.
9.7 State pipe insulation.
9.8 State different types of pipe insulations.
9.9 Describe vibration and Expansion control of piping system.

HVAC-334: CONTROLS AND INSTRUMENTATION

T	P	C
3	3	4

Total contact hours:

Theory 96 hours
Practical 96 hours

Prerequisites:

(i) Fundamentals and Principles of Refrigeration, Heating, Ventilating and Air-conditioning.
(ii) Workshop Practice.

AIM: At the end of the course, the students will be able to:-

(i) Understand the basic principles of electronics
(ii) Understand the principles of selection, installation and operation of various types of Electrical, Electronic, Pneumatic, Electro-mechanical and Electro-pneumatic controls
(iii) Understand the operation of control elements, such as sensors, controllers, actuators and related accessories
(iv) Understand the role of instruments commonly used in HVAC&R control systems.

1. INTRODUCTION OF CONTROLS 12 Hours

1.1. Basic control theory
1.2. Definition of terminology used in control system
- 1.2.1. Control system
- 1.2.2. Control device
- 1.2.3. Control agent
- 1.2.4. Controlled variable
- 1.2.5 Digital & Analog Input and Outputs
- 1.2.6 Control media
- 1.2.7. Desired value
- 1.2.8. Set point
- 1.2.9. Differential
- 1.2.10. Proportional band
- 1.2.11. Cycling
- 1.2.12. Open loop control system
- 1.2.13. Closed loop control system
- 1.2.14. Block / Schematic Diagram
- 1.2.15 Logic Controls
- 1.2.16 Direct Digital Controls (DDC)

1.3. Basic Functions of parts
- 1.3.1. Controllers
- 1.3.2. Sensors
- 1.3.3. Actuators
- 1.3.4. Accessories

2. CONTROL SYSTEMS 3 Hours

- 2.1. Two position
- 2.2. Timed two position
- 2.3. Multi-position control
- 2.4. Proportional control
- 2.5. Floating control
- 2.6. Self-contained controls

3. TEMPERATURE CONTROL & SENSORS 3 Hours

- 3.1. Thermostat and its types
- 3.2. Thermocouple
- 3.3. Electrical resistance
- 3.4. Bi-metal

4. HUMIDITY SENSORS 3 Hours

- 4.1. Hygroscopic Humidistat
- 4.2. Electrical Humidistat
- 4.3. Electronic Humidistat
- 4.4. Photoelectric sensor type Humidistat

5. PRESSURE SENSORS 2 Hours

- 5.1. Bellows
- 5.2. Diaphragm
- 5.3. Bourdon tube
- 5.4 Transducers as pressure sensors

6. LIQUID LEVEL AND CONSTANT FLOW CONTROL 1 Hour

- 6.1. Float valve
- 6.2. Circuit setter

7. FLOW CONTROL DEVICES 12 Hours

- 7.1. Automatic control valves terminology
- 7.2. Types of automatic control valves
  - 7.2.1. Single-seated valve
  - 7.2.2. Pilot piston valve
  - 7.2.3. Double-seated valve
  - 7.2.4. 3-way mixing valve
  - 7.2.5. 3-way diverting valve
- 7.3. Valve Actuators
  - 7.3.1 Solenoid
  - 7.3.2. Electric motor
  - 7.3.3. Pneumatic diaphragm
- 7.4. Damper
  - 7.4.1. Single leaf
  - 7.4.2. Multi-leaf
  - 7.4.3. Butterfly
  - 7.4.4. Opposed blade

7.4.5. Damper actuators/motors
7.4.5.1 Solenoid / Hydraulic
7.4.5.2 Motorized
7.4.5.3 Pneumatic Diaphragm

8. ELECTRICAL CONTROL 6 Hours

8.1. Electrical controls and its advantages
8.2. Electrical control elements, Bridge circuit theory
8.3. Over loads
8.4. Timers
8.5. Relays
8.6. Selection and design consideration

9. REVIEW OF FUNDAMENTALS OF ELECTRONICS CONTROLS APPLIED TO HVAC&R SYSTEMS 10 Hours

9.1 Terms used in electronics
9.2 Electronic controls and its advantages
9.3 Electronic control components:
9.3.1. Diodes
9.3.2. Transducers
9.3.3. Transistors
9.3.4. Rectifiers
9.3.5. Amplifiers
9.3.6. Potentiometer
9.3.7. Thermistor
9.4 Conductivity controller
9.5 pH controller

10. PNEUMATIC CONTROLS 8 Hours

10.1. Pneumatic controls and its advantages
10.2. Compressed air- source of power
10.2.1. Air-compressor (oil free type) and storage tanks
10.2.2. Compressed air filters
10.2.3. Refrigerated driers
10.2.4. Compressed air lines and accessories

11. SELF CONTAINED CONTROLS 2 Hours

11.1. Automatic expansion valve
11.2. Thermostatic expansion valve
11.3 High Side & Low Side Float Valve

12. CONTROL APPLICATIONS 2 Hours

12.1. Individual control
12.2. Single zone control
12.3. Multi-zone control

13. ELECTRICAL CONTROL CIRCUITS 11 Hours

13.1 Two-wire control circuits

13.1.1. Line voltage
13.1.2. Low voltage

13.2. Three-wire two position control circuits
13.2.1. Double-throw three-wire circuit
13.2.2. Complete three wire control circuit

13.3 Multi-position control Circuits.
13.3.1. Full off circuit
13.3.2. Part on circuit
13.3.3. Full on circuit

13.4 Floating control circuits
13.4.1. Typical floating control circuit

13.5 Proportional control circuits
13.5.1 Proportional controllers
13.5.2. Proportional motor
13.5.3. Balancing relay
13.5.4. Motor balancing potentiometer

14. CENTRAL COMPUTER CONTROLLED BUILDING HVAC&R MANAGEMENT SYSTEM 8 Hours

14.1. Introduction of Building Management System (BMS) for Monitoring, Switching and Control and Integrated Building Management System (IBMS)
14.2. Microprocessor based direct digital controls (DDC) and its advantages
14.3. Study the microprocessor controller and its programming
14.4. Understanding logics
14.5. Data Logging / Trend Logging of building management system
14.6 Energy Optimization through BMS / IBMS

15. PREVENTIVE MAINTENANCE (PM) & SCHEDULING 7 Hours

15.1 Preventive Maintenance (PM) and calibration of various control system
15.2 Preparation of sentence schedules:
15.2.1. Daily maintenance schedule
15.2.2. Weekly maintenance schedule
15.2.3. Monthly maintenance schedule
15.2.4. Yearly maintenance schedule

16. INSTRUMENTS 6 Hours

16.1. Thermometers
16.1.1. Pipe line thermometers
16.1.2. Duct thermometers
16.2. Flow recorders
16.3. Pressure recorders
16.4. Temperature recorders
16.5. Temperature and flow recorders
16.6. Velocity meters
16.7. Manometers
16.8. pH meters
16.9. Conductivity meters
16.10. Flue gas analyzer
16.11. Electronic leak detectors

16.12 Ultrasonic Flow Meters

RECOMMENDED BOOKS

1. Automatic Controls of Heating and Air-conditioning by John E. Hains
2. ASHRAE Hand Book- Application & Equipment Volume
3. Book on Controls by Honeywell
4. Manual prepared by National Institute of Science & Technology (NISTE), Ministry of Education, Government of Pakistan, Islamabad

HVAC-334: CONTROLS AND INSTRUMENTATION

INSTRUCTIONAL OBJECTIVES

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

1. UNDERSTAND THE ROLE OF CONTROLS, CONTROL TERMINOLOGY AND BASIC FUNCTION OF COMPONENTS USED IN CONTROL SYSTEMS

- 1.1. State the basic control theory
- 1.2. State the terminology used in control system
  - 1.2.1. Define control system
  - 1.2.2. Define Digital & Analog Inputs and Outputs, controlled variable, control medium, desired value.
  - 1.2.3. Describe set point, differential, proportional band, cycling
  - 1.2.4. Explain open loop control system
  - 1.2.5. Explain closed loop control system
  - 1.2.6. Describe block diagram
- 1.3. Explain basic functions of parts
  - 1.3.1. Define controllers, sensors, actuators, accessories
- 1.4. Explain safety controls

2. UNDERSTAND THE FUNCTION AND USE OF CONTROL SYSTEMS

- 2.1. Define two position
- 2.2. Explain multi-position control
- 2.3. Describe proportional control
- 2.4. Define floating control
- 2.5. Explain self-contained controls

3. UNDERSTAND THE FUNCTION AND USE OF TEMPERATURE CONTROLS AND SENSORS

- 3.1. Explain thermostat and its types
- 3.2. Define thermocouples
- 3.3. State electrical resistance
- 3.4. Define bi-metal

4. UNDERSTAND THE ROLE AND FUNCTION OF HUMIDITY SENSORS

- 4.1. Define hygroscopic humidistat
- 4.2. Define electrical humidistat
- 4.3. Define electronic humidistat
- 4.4. Explain photoelectric sensor type humidistat

5. UNDERSTAND THE FUNCTION AND USE OF PRESSURE SENSORS

5.1. Describe bellows
5.2. Define diaphragm
5.3. Define bourdon tube
5.4 Describe Transducers

6. UNDERSTAND THE FUNCTION AND USE OF LIQUID LEVEL AND CONSTANT FLOW CONTROLS

6.1. Define float valve
6.2. State circuit setter

7. UNDERSTAND THE WORKING PRINCIPLES AND USE OF FLOW CONTROL DEVICES

7.1. Define automatic control valves terminology
7.2. Enlist the types of automatic control valves
  7.2.1. Define single-seated valve, pilot piston valve, double-seated valve
  7.2.2. Explain 3-way mixing valve
  7.2.3. Explain 3-way diverting valve
7.3. Explain valve Actuators
  7.3.1 Explain solenoid
  7.3.2. Describe electric motor
  7.3.3. Explain pneumatic diaphragm
7.4. Explain dampers
  7.4.1. Define single leaf, multi-leaf, butterfly, and opposed blade
  7.4.2. Explain damper actuators/motors Solenoid / Hydraulic, Motorized and Pneumatic Diaphragm

8. UNDERSTAND THE FUNCTION AND THE USE OF ELECTRIC CONTROLS

8.1. Describe electric controls and its advantages
8.2. Explain electric control elements, Bridge circuit theory
8.3. Explain over loads
8.4. Define timers
8.5. Explain relays
8.6. Explain selection and design consideration

9. UNDERSTAND THE FUNDAMENTALS OF ELECTRONICS CONTROLS APPLIED TO HVAC&R SYSTEMS

9.1 Define terms used in electronics
9.2 Describe electronic controls and its advantages
9.3 Explain electronic control components:
  9.3.1 Define diodes, transducers, transistors, rectifiers, amplifiers, potentiometer, and thermistor
9.4 Explain conductivity controller
9.5 Define pH controller

10. UNDERSTAND THE WORKING PRINCIPLES AND USE OF PNEUMATIC CONTROLS

10.1. Explain pneumatic controls and its advantages

10.2. Define compressed air-source of power
10.2.1. Define air-compressor (oil free type) and storage tanks, compressed air filters
10.2.2. State refrigerated driers
10.2.3. Define compressed air lines and accessories

11. UNDERSTAND THE ROLE AND USE OF SELF CONTAINED CONTROLS

11.1. Explain automatic expansion valve
11.2. Explain thermostatic expansion valve
11.3 Explain High and Low Side Float Valve

12. UNDERSTAND THE SYSTEM OF CONTROLS AND THEIR USEFULNESS

12.1. Define individual control
12.2. Explain single zone control
12.3. Describe multi-zone control

13. UNDERSTAND THE DIFFERENT TYPES OF ELECTRIC CONTROL CIRCUITS

13.1 Draw two-wire control circuits, line voltage circuits, low voltage circuits
13.2. Draw three-wire two position control circuits, double-throw three-wire circuit, complete three wire control circuit
13.3. Draw multi-position control circuits, full off circuit, part on circuit, full on circuit.
13.4. Draw floating control circuits, typical floating control circuit
13.5. Draw Proportional control circuits
13.5.1. Explain proportional controllers, proportional motor, balancing relay, motor balancing potentiometer

14. UNDERSTAND THE APPLICATIONS OF HVAC&R CENTRALLY COMPUTERIZED CONTROLLED BUILDING MANAGEMENT SYSTEMS

14.1. Explain building management system (BMS) and Integrated Building Management System (IBMS)
14.2. Explain microprocessor based direct digital control (DDC) and its advantages
14.3. Describe the microprocessor controller and its programming
14.4. Explain the logics
14.5. Calculate the data generation of building management system
14.6 Describe Energy Optimization through BMS / IBMS

15. UNDERSTAND THE METHODS AND TECHNIQUES OF MAINTENANCE

15.1 Explain the maintenance and calibration of various control system
15.2 Prepare the maintenance schedules:
15.2.1. Prepare and notify the daily maintenance schedule
15.2.2. Prepare and notify the weekly maintenance schedule
15.2.3. Prepare and notify the monthly maintenance schedule
15.2.4. Prepare and notify the yearly maintenance schedule

16. UNDERSTAND THE APPLICATION AND USE OF INSTRUMENTS

16.1. Explain Thermometers, Pipe line thermometers, Duct thermometers

16.2. Define Flow recorders, Pressure recorders, Temperature recorders, Temperature and Flow recorders
16.3. Explain Velocity meters
16.4. Explain manometers
16.5. Define pH meters, conductivity meters
16.6. Explain flue gas analyzer, electronic leak detectors and ultrasonic flow meters.

HVAC-334: CONTROLS AND INSTRUMENTATION

LIST OF PRACTICALS 96 Hours

On completion of the course, the trainees will be able to;

1. Check and connect a heating thermostat
2. Check and connect a combination thermostat
3. Check solenoid valve
4. Identify different temperature sensing elements
5. Determine the accuracy of a thermostat while in operation
6. Identification of a relay contactor and starter
7. Checking a packaged sequencer
8. Checking a fan limit control
9. Evaluating duct size
10. Measure air velocity in a duct using a anemometer
11. Install and use a water manometer
12. Measure air velocity in a duct system using a pitot tube
13. Measure air velocity in a duct using a velocity meter
14. Measure pressure drop through a filter
15. Identification controls of a central air conditioning system
16. Control checkout on an all-weather system
17. Checking a four-way valve during the heating and cooling cycles
18. Check low voltage field control circuits at the individual components
19. Calculate the comfort cooling and heating load for an assigned space
20. Sketch a two wire control circuit
21. Sketch a three wire control circuit
22. Sketch a floating control circuit
23. Sketch a multi-position control circuit
24. Sketch a Wheat Stone bridge
25. Study the differential adjustments in different thermostats
26. Study the elements of a typical pneumatic system
27. Study the different types of recorders (Temperature, Flow, Humidity etc.)
28. Study the use of water balancing instruments such as a pressure gauge, thermometer, flow indicators etc.
29. Analysis of multi-story commercial/industrial buildings for zoning
30. Visit to commercial/industrial buildings to study the application and circuit diagram of different controls used in HVAC&R systems

HVAC-342: INDUSTRIAL REFRIGERATION AND AIR CONDITIONING MACHINES & EQUIPMENT

T	P	C
2	0	2

Total contact hours:

Theory 64 hours

Pre-requisite:

1. Knowledge of science subjects.
2. Air-conditioning workshop Practice.

AIM: At the end of the course, the students will be able to:

1. Knowledge the working principles of industrial absorption, centrifugal and steam jet refrigeration system.
2. Understand the working principles of air washers, cooling tower designs and other industrial refrigeration equipments.

1. ABSORPTION AIR CONDITIONING SYSTEM. 12 Hours

1.1 Fundamentals of Vapor Absorption Cycle.
1.2 Construction, major parts and working principle of absorption cold generator
1.3 Types of absorption machine according to construction (Single Shell & Double Shell)
1.4 Types of absorption machine according to effect (Single Generator & Double Generator).
1.5. Types of absorption machine according to firing (Steam-fired, Hot Water Fired and Direct Fired)
1.6 Causes of crystallization and its remedies.
1.7 Cooling water control in absorption machine
1.8 Special applications.

2. STEAM JET REFRIGERATION SYSTEM. 2 Hours

2.1 Introduction of Steam Jet Refrigeration System.
2.2 Working principle and constructional features of Steam Jet Refrigeration System.
2.3 Detail of major parts of the machine.
2.4 Special applications.

3. AIR WASHER SYSTEM. 6 Hours

3.1 Air washers
3.2 Types of air washers
3.3 Air washer computations.
3.4 Cooling and humidification.
3.5 Heating and humidification.
3.6 Applications of air washers.
3.7 Problem solving

4. CENTRIFUGAL AIR CONDITIONING SYSTEM 11 Hours

4.1 Centrifugal compressor.
4.2 Types, construction of centrifugal compressors and lubrication system.

4.3 Efficiency and performance of centrifugal liquid chillers.
4.4. Capacity control of centrifugal Chillers.
4.5 Application of centrifugal Chillers.
4.6 Variable Frequency Drive (VFD) and Variable Speed Drive (VSD)
4.7 Steam-driven Chillers (Steam as Prime Mover)

5. SCREW CHILLERS 08 Hours

5.1 Screw compressor.
5.2 Types (Single & Twin), construction of Screw compressors and lubrication system.
5.3 Efficiency and performance of Screw liquid chillers.
5.4. Capacity control of Screw Chillers.
5.5 Application of Screw Chillers.
5.6 Variable Frequency Drive (VFD) and Variable Speed Drive (VSD)

6. COMMERCIAL AIR CONDITIONING SYSTEM. 14 Hours

6.1 Types of commercial air-conditioning systems

6.1.1 Packaged units.
6.1.2 Roof-top units
6.1.3 Split units.
6.1.4 Multi-evaporator (mini) split system
6.1.5 Centrally air conditioning system and ancillary equipment (water chillers, boilers, cooling towers, AHUs, FCUs, VAV Units, circulating pumps, heat exchangers, air separator, oil separators, compression tank expansion tank etc.)
6.1.6 Variable Refrigerant Flow (VRF)

6.2 Flow diagram of centrally air-conditioning system.
6.3 Electrical circuit diagram of packaged units.
6.4 Electrical circuit diagram of split units.

7. HUMIDIFIERS AND DEHUMIDIFIERS. 5 Hours

7.1 Purpose of humidifiers and dehumidifiers (residential & industrial)
7.1 Types of humidifiers
7.2 Types of dehumidifiers.
7.3 Working principles and construction detail of humidifiers and dehumidifiers .

8. ICE PLANTS. 6 Hours

8.1 Commercial ice plant (reciprocating vapor compression system using ammonia as refrigerant).
8.2 Construction detail of refrigeration cycle of ice plant.
8.3 Safety Measure for Ammonia-based System
8.4. Cooling load calculations.

REFERENCE BOOK

1. ASHRAE Systems & Equipment 2012
2. Modern Refrigeration and Air-conditioning by Althouse.
3. Principles of Air conditioning by E.G. Pita
4. Industrial Refrigeration and Air Conditioning Machines & Equipment (Manual), Ministry of Education, Islamabad.
5. Train Air-conditioning manual.
6. Principles of Refrigeration by R. J. Dossat
7. Manual prepared by National Institute of Science & Technology (NISTE), Ministry of Education, Government of Pakistan, Islamabad

HVAC-342: INDUSTRIAL REFRIGERATION & AIR CONDITIONING MACHINE & EQUIPMENT.

INSTRUCTIONAL OBJECTIVES:

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

1. UNDERSTAND THE CONSTRUCTION AND WORKING PRINCIPLES OF AN ABSORPTION REFRIGERATION MACHINE.

1.1 State the fundamentals of absorption cycle.
1.2 Explain the construction, major parts and working principle of absorption cold generator
1.3 Explain the types of absorption machine according to construction (single shell & double shell)
1.4 Explain the types of absorption machine according to effect (single generator & double generator).
1.5. Explain the types of absorption machine according to firing (steam-fired, hot water fired and direct fired)
1.6 State the causes of crystallization and its remedies.
1.7 Describe cooling water control in absorption machine and its special applications.

2. UNDERSTAND THE STEAM JET REFRIGERATION SYSTEM.

2.1 Define the introduction of steam jet refrigeration system.
2.2 Explain the working principle and constructional features of steam jet refrigeration system.
2.3 Explain the major parts of the machine and its special applications.

3. UNDERSTAND THE WORKING PRINCIPLE OF AIR WASHER AND ITS APPLICATIONS

3.1. Define air washer
3.2 Define types of air washers
3.3 Process air washer computations.
3.4 Explain cooling and humidification.
3.5 Explain heating and humidification.
3.6 Describe applications of air washers.
3.7 Solve problems

4. UNDERSTAND THE CONSTRUCTION AND WORKING PRINCIPLES OF CENTRIFUGAL LIQUID CHILLERS.

4.1 State centrifugal air conditioning system.
4.2 Explain the types, major components and lubrication system of machine.
4.3 Explain the working principle of machine.
4.4 Calculate the Efficiency and performance of centrifugal liquid chiller.
4.5 Explain capacity control of machine.
4.6 Describe chiller startup and shut down procedure
4.7 Describe hot gas by pass control, condenser water regulation, butterfly dampers, speed control, variable inlet, guide inlets, VFDs and VSDs.

4.8 Describe Steam Driven Chillers (Steam as prime mover)
4.9 Describe the application of centrifugal chillers.

5. SCREW CHILLERS

5.1 Define Screw compressor.
5.2 Describe Types (Single & Twin), construction of Screw compressors and lubrication system.
5.3 Describe Efficiency and performance of Screw liquid chillers.
5.4. Describe Capacity control of Screw Chillers.
5.5 Describe Application of Screw Chillers.
5.6 Describe Variable Frequency Drive (VFD) and Variable Speed Drive (VSD)

6. UNDERSTAND DIFFERENT TYPES OF COMMERCIAL AIR CONDITIONING SYSTEM.

6.1 Describe Types of commercial air-conditioning systems
- 6.1.1 Packaged units.
- 6.1.2 Roof-top units
- 6.1.3 Split units.
- 6.1.4 Multi-evaporator (mini) split system
- 6.1.5 Centrally air conditioning system and ancillary equipment (water chillers, boilers, cooling towers, AHUs, FCUs, VAV Units, circulating pumps, heat exchangers, air separator, oil separators, compression tank expansion tank etc.)
- 6.1.6 Variable Refrigerant Flow (VRF)

6.2 Explain Flow diagram of centrally air-conditioning system.
6.3 Explain Electrical circuit diagram of packaged units.
6.4 Explain Electrical circuit diagram of split units.

7 UNDERSTAND THE DIFFERENT TYPES OF HUMIDIFIERS AND DEHUMIDIFIERS.

7.1 State the purpose of humidifiers and dehumidifiers (residential & industrial).
7.1 Explain the types of humidifiers (pan, pad and automizing type)
7.2 Explain the types of dehumidifiers (cooling coil and chemical)
7.3 State the working principles and construction detail of humidifiers and dehumidifiers.

8 UNDERSTAND THE ICE PLANTS

8.1 Describe the commercial ice plant (reciprocating vapor compression system using ammonia as refrigerant).
8.2 Explain construction detail of refrigeration cycle of ice plant.
8.3. Calculate the cooling load capacity of ice plant.
8.4 Describe Safety Measures for Ammonia-based Systems

HVAC-353: HEAT TRANSFER AND REFRIGERATION CALCULATIONS

T	P	C
3	0	3

Total contact hours:

Theory 96 hours

Prerequisites.

1. Fundamentals of Mathematics
2. Fundamentals of Thermodynamics

AIMS: The students will be able to:

1. Understand heat transfer applied to the Refrigeration and Air Conditioning.
2. Design Refrigeration and Air Conditioning components

1. METHODS OF HEAT TRANSFER. 12 Hours

- 1.1 Introduction to Heat Transfer.
- 1.2. Methods of heat transfer, conduction, convection and radiation.
- 1.3. Heat transfer by conduction through homogeneous and composite structures.
- 1.4 Absorption, Reflection, Transmission, Black Body, Plank's Law, Kirchoff's Law, Emissivity and Absorptivity
- 1.5 Insulation and their properties
  - 1.5.1 Thermal
  - 1.5.2 Mechanical

2. DETERMINATION OF OVER ALL CO-EFFICIENT OF HEAT TRANSFER 9 hours

- 2.1 Thermal conductivity of materials. (Solid, Liquid and Gases)
- . 2.2 Thermal conductance of material.
- 2.3 Thermal resistance of material.
- 2.4 Determination of "U" factor by calculation and formulas.
- 2.5 "U" factor of insulated pipe.
- 2.6 Flow of heat through walls
- 2.7 Flow of heat through walls with varying outdoor temperatures.
- 2.8 Problem Solving.

3. PROPERTIES OF INSULATORS AND CONDUCTORS. 20 Hours

- 3.1 General building insulation practice
  - 3.1.1 Wood frame construction
  - 3.1.2 Steel frame construction
  - 3.1.3 Masonry frame construction
- 3.2 General industrial insulation practice
  - 3.2.1 Pipes
  - 3.2.2 Ducts
  - 3.2.3 Tanks & Vessels
- 3.3 Heat Transfer Factors
  - 3.3.1 Fluid factor.

3.3.2 Tube factor
3.3.3 Temperature factor.
3.3.4 Surface factor
3.3.5 Designing factor.

3.4 Heat surface area calculation for air cooled finned coil condenser
3.5 Heat surface area calculation for water cooled condenser
3.6 Heat surface area calculation for evaporator coil
3.7 Common window glass
3.8 Shade glass
3.9 Other types of glass
3.10 Glass blocks.
3.11 Heat gain through glass.
3.12 Problem solving

4. SIMPLE SATURATED CYCLE. 15 Hours

4.1 Vapor Compression System
4.2 Division of System
4.3 Vapor Compression Cycle
4.3.1 Expansion process.
4.3.2 Vaporizing process
4.3.3 Compression process.
4.3.4 Condensing process.
4.4 Pressure enthalpy Diagram
4.5 Simple Saturated Cycle on p-h Diagram
4.6 Tracing of simple saturated cycle on pressure enthalpy chart (ph diagram) for R-12 and R-22
4.7 Refrigerating Effect, Mass flow rate, heat of compression, latent heat rejected at condenser, sensible heat rejected at condenser, total heat rejected at condenser, coefficient of performance (COP), and compressor capacity in kW/HP calculations.
4.8 Problem solving on ph chart.

5. ACTUAL REFRIGERATION CYCLE. 12 Hours

5.1 Deviation from the simple saturated cycle
5.2 The effect of super heat the suction vapour.
5.3 The effect of subcooling liquid.
5.4 Change in refrigerating effect due to change in evaporator temperature/pressure.
5.5 Change in refrigerating effect due to change in condensing temperature/pressure.
5.6 The effect of pressure losses resulting from friction.
5.7 Solving of problems on ph chart

6. PERFORMANCE/ EFFICIENCY OF REFRIGERATION CYCLE 12 Hours

6.1 Heat pump
6.2 Refrigerating effect (RE) of heat pump
6.3 Theoretical horse power of heat pump.
6.4 Co-efficient of performance of heat pump

6.5 Cycle efficiency of heat pump.
6.6 Multistage compression
6.6.1 Booster System
6.6.2 Intercoolers
6.6.3 Direct Staging Versus Cascade Staging

7. SIZING AND SELECTION OF REFRIGERANT LINES & ASSECCORIES **6** Hours

7.1 Sizing and selection of hot vapor line (Discharge line)
7.2 Sizing of liquid line
7.3 Liquid indicator and sight glass.
7.4 Sizing and selection of expansion valve.
7.5 Sizing and Selection of cooling coil in term of heat contents.
7.6 Selection of suction line.

8. SORBENTS, DESICANTS & FUELS 10 Hours

8.1 Sorbents
8.2 Applications of Sorbents
8.3 Absorbents and Adsorbents
8.4 Solid & Liquid Absorbents
8.5 Solid Adsorbents
8.6 Purpose & classification of Fuels
8.7 Combustion of Fuels
8.8 An Analysis of Fuel by Weight and Volume
8.9 Calorific Value of Fuels (Higher & Lower)
8.10 Problem Solving

RECOMMENDED BOOKS:

1. Principle of Refrigeration by R.J. Dossat.
2. Refrigeration, Air-conditioning & Cold storage by R.C.Gunther.
3. Manual of Heat Transfer by Ministry of Education.
4. ASHRAE Handbook- Fundamental & Equipment Volume
5. Hear Transfer in Refrigeration Materials and Calculations (Manual), Ministry of Education , Islamabad.
6. Manual prepared by National Institute of Science & Technology (NISTE), Ministry of Education, Government of Pakistan, Islamabad

HVAC-353: HEAT TRANSFER AND REFRIGERATION CALCULATIONS

INSTRUCTIONAL OBJECTIVES

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

1. UNDERSTAND THE METHODS OF HEAT TRANSFER.

- 1.1 Define heat transfer.
- 1.2. Explain the methods of heat transfer, conduction, convection and radiation.
- 1.3. State heat transfer by conduction through homogeneous and composite structures.
- 1.4 Define Absorption, Reflection, Transmission, Black Body, Plank's Law, Kirchoff's Law, Emissivity and Absorptivity
- 1.5 Explain Insulation and their properties
  - 1.5.1 Thermal
  - 1.5.2 Mechanical

2. UNDERSTAND TO DETERMINATE OVER ALL CO-EFFICIENT OF HEAT TRANSMISSION FACTOR.

- 2.1 Define thermal conductivity of materials.
- . 2.2 Define thermal conductance of material.
- 2.3 Define thermal resistance of material.
- 2.4 Determine the "U" factor by calculation and formulas.
- 2.5 State "U" factor of insulated pipe.
- 2.6 Explain the flow of heat through walls
- 2.7 Describe the flow of heat through walls with varying outdoor temperatures.
- 2.8 Solve problems.

3. PROPERTIES OF INSULATORS AND CONDUCTORS.

- 3.1 Explain General building insulation practice
  - 3.1.1 Wood frame construction
  - 3.1.2 Steel frame construction
  - 3.1.3 Masonry frame construction
- 3.2 Explain General industrial insulation practice
  - 3.2.1 Pipes
  - 3.2.2 Ducts
  - 3.2.3 Tanks & Vessels
- 3.3 Describe Heat Transfer Factors
  - 3.3.1 Fluid factor.
  - 3.3.2 Tube factor
  - 3.3.3 Temperature factor.
  - 3.3.4 Surface factor
  - 3.3.5 Designing factor.
- 3.4 Explain Heat surface area calculation for air cooled finned coil condenser
- 3.5 Explain Heat surface area calculation for water cooled condenser
- 3.6 Explain Heat surface area calculation for evaporator coil
- 3.7 Define Common window glass
- 3.8 Define Shade glass

3.9 Define Other types of glass
3.10 Define Glass blocks.
3.11 Calculate Heat gain through glass.
3.12 Problem solving

4. SIMPLE SATURATED CYCLE.

4.1 Explain Vapor Compression System
4.2 Explain Division of System
4.3 Explain Vapor Compression Cycle
  4.3.1 Expansion process.
  4.3.2 Vaporizing process
  4.3.3 Compression process.
  4.3.4 Condensing process.
4.4 Explain Pressure enthalpy Diagram
4.5 Explain Simple Saturated Cycle on p-h Diagram
4.6 Trace simple saturated cycle on pressure enthalpy chart (ph diagram) for R-12 and R-22
4.7 Calculate Refrigerating Effect, Mass flow rate, heat of compression, latent heat rejected at condenser, sensible heat rejected at condenser, total heat rejected at condenser, coefficient of performance (COP), and compressor capacity in kW/HP calculations.
4.8 Problem solving on ph chart.

5. UNDERSTAND THE ACTUAL REFRIGERATION CYCLE

5.1 Explain deviation from the simple saturated cycle
5.2 Describe the effect of super heat the suction vapour.
5.3 Describe the effect of subcooling liquid.
5.4 Explain the change in refrigerating effect due to change in evaporator temperature/pressure.
5.5 Explain the change in refrigerating effect due to change in condensing temperature/pressure.
5.6 State the effect of pressure losses resulting from friction.
5.7 Solve problems on ph chart

6. UNDERSTAND THE PERFORMANCE/ EFFICIENCY OF REFRIGERATION CYCLE (HEAT PUMP)

6.1 Explain heat pump
6.2 Explain refrigerating effect (RE) of heat pump
6.3 State theoretical horse power of heat pump.
6.4 Define co-efficient of performance of heat pump
6.5 Describe the cycle efficiency of heat pump.
6.6 Explain the multistage compression (booster, intercooler)
6.7 Distinguish between direct staging and cascade staging

7. DETERMINE THE SIZING AND SELECTION OF CONDENSER, COOLING COIL AND REFRIGERANT LINES

7.1 Explain the procedure for sizing and selection of hot vapor line (discharge line)
7.2 Explain the procedure for sizing of liquid line

7.3 Explain the procedure for liquid indicator and sight glass.
7.4 Explain the procedure for sizing and selection of expansion valve.
7.6 Explain the procedure for selection of suction line.

8. SORBENTS, DESICANTS & FUELS

8.1 Describe Sorbents
8.2 Applications of Sorbents
8.3 Describe Absorbents and Adsorbents
8.4 Describe Solid & Liquid Absorbents
8.5 Describe Solid Adsorbents
8.6 Describe Purpose & classification of Fuels
8.7 Describe Combustion of Fuels
8.8 Analysis of Fuel by Weight and Volume
8.9 Describe Calorific Value of Fuels (Higher & Lower)
8.10 Problem Solving

HVAC-363: WORKSHOP PRACTICE-III **Total: 288 Hours**

LIST OF PRACTICALS 144 Hours

On completion of the course, the trainees will be able to;

1. Check/install and test a rooftop system
2. Check/install and operate a rooftop heating system
3. Check/install a rooftop comfort cooling system
4. Check/install a heat pump
5. Locate trouble in a window type comfort cooler
6. Locate trouble in a heat pump
7. Locate trouble in a water chiller
8. Check/install a chilled water cooling system
9. Check/install a reach-in cabinet system
10. Check/install a low-temperature system (open case)
11. Check/install a walk-in cooler system
12. Check/install a multi-temperature system
13. Check/install an evaporative condenser or cooling tower
14. Check/install a remote air-cooled condenser
15. Check/install an electrical and hot gas defrost system
16. Locate trouble in a hot gas defrost hermetic system
17. Locate trouble in a water-cooled system
18. Locate trouble in an icemaker
19. Locate trouble in a low temperature system
20. Draw a diagram of a split air conditioner
21. Draw a diagram of a packaged air conditioner
22. Draw a system diagram of a packaged air conditioner with forced air-cooling tower and circulating pump
23. Determine the range, approach and performance of a cooling tower
24. Draw a system diagram of an air washer including centrifugal fans, humidity control and circulating pumps
25. To make system diagram of an air conditioning system with centrifugal fan, spray type humidifier, direct expansion refrigeration coils, filters, ducts, compressor, steam /water coil and controls
26. Overhauling and Alignment of Centrifugal pump
27. Draw a system flow diagram of chilled/hot water air conditioning system

Note: 1: As required, visits to different air conditioning plants for the above PRACTICALS may be arranged otherwise may be performed in the lab if trainers and equipment are available at the institute
Note: 2: One full day may be dedicated for monthly field visits.

Projects to be study/completed **144 Hours**

1. Remove, clean, install and operate an oil separator
2. Remove, replace or clean a thermostatic expansion valve strainer

3. Remove, test, install and adjust a thermostatic expansion valve
4. Dismantle, inspect, assemble and test a two-temperature valve
5. Commercial refrigeration systems – test the efficiency of a compressor
6. Service a commercial system
7. Remove, inspect and adjust a commercial type pressure control
8. Test and adjust low-pressure cutout
9. Install gauges on an external drive refrigeration system
10. Install a power humidifier in a duct system in a duct system
11. Operate and test a baseboard electrical resistance system
12. Measure noise levels with the help sound level meter
13. Install and adjust a water-regulating valve
14. Remove, test, install and adjust a pressure operated water valve
15. Methods of checking compressor (motor) electrical circuits.
16. Automobile air conditioning component and gauge connection
17. Automotive air conditioning performance test.

Air Conditioning and Heat Pump Simulation Troubleshooting

Practice of problem solving on air-conditioning and heat pumps system design/simulation program. Using a demo-fault that how the system operates under the following selected fault conditions. Demonstrate and every student repair the fault data (fault activity, log-on time, repair actions etc.)

- Refrigerant undercharge
- Refrigerant overcharge
- Outdoor TXV power element dead
- Indoor TXV bulb makes poor contact
- Compressor stuck (won't start)
- Outdoor check valve leaking
- Indoor check valve leaking
- Reversing valve won't fully shift position
- Indoor liquid line drier clogged
- Indoor air filter extremely dirty
- Indoor coil extremely dirty
- Outdoor unit airflow blocked
- Indoor fan motor stuck (won't start)
- Compressor suction valve broken
- Air in refrigeration system
- Compressor run winding open
- Compressor run and start windings shorted
- Compressor start winding shorted to ground
- Compressor overload stuck open
- Compressor run capacitor shorted
- Contactor coil open
- Contactor contact CC-1 high-resistance
- Outdoor fan motor winding open
- Indoor fan motor run capacitor open
- Reversing valve solenoid coil open
- Defrost relay coil open
- Defrost thermostat stuck open

- Defrost timer motor winding open
- Defrost timer contact DTC-1 stuck closed
- Defrost relay contact DFR-1 stuck open
- Outdoor thermostat stuck open
- Transformer secondary winding open
- Indoor fan relay coil open
- Indoor fan relay contact IFR-1 stuck open
- Control wire (G) open
- Heat thermostat (TSH) stuck closed
- Auxiliary heat relay HR1 coil open
- Auxiliary heater element HTR2 open
- Auxiliary heater limit switch LS1 stuck open
- No line voltage at outdoor unit

BIBLIOGRAPHY

LIST OF PRESCRIBED BOOKS FOR REFRIGERATION & AIR-CONDITIONING

Sr. No	Name/Title of Book	Author	Publisher	Edition/Year
1	Modern Air-Conditioning Practice	Norman C. Harris	McGraw – Hill Book Co. New York	3rd 1983
2	Trane Air-Conditioning Manual	Trane Compay	The Trane Company La Crosse Winconsin	1984
3	Refrigeration, Air-Conditioning & Cold Storage	Raymond C. Gunther	Chilton Books, Philadelphia, New York	1957
4	Air-Conditioning Principles & Systems An Energy Approach	E.G. Pita	John Wiley & Sons, New York	1981
5	Principal of Air-conditioning	V.Paul Lang	CBS Publishers & Distributors,New Dehli, India	1st 1987 or 1988
6	Principles of Refrigeration (S.I Version)	Roy J. Dossat	John Wiley & Sons Inc. New York	3rd 1991
7	Air-Conditioning & Refrigeration	Severn & Fellows	Toppan Company Ltd. Tokyo, Japan (John Wiley & Sons Inc.)	1889
8	Sheet Metal Work	Robert. E. Smith	Meknight & Meknight Publichsing Co. Bloomington, Illinois	1952
9	Automatic Control of Heating and Air Conditioning	John E. Hains	McGrwe-Hill Book Co.Inc.	1961
10	Sheet Metal Shop Practice	Bruce & Meyer	D.B. Taraporevala Sons & Co. (Pvt) Ltd, Bombay (American Technical Society)	1972

11	Fundamentals of Pipe Drafting	Charles H. Thompson	John Wiley & Son, Inc. New Your	1958
12	Modern Refrigeration & Air Conditioning	Althouse Turnquist and Bracciano	The Goodheart-Wilcox Co.,Inc. South Holland, Illinois	1996
13	Refrigeration Principles & Systems	Edward G. Pita	John Wiley & Sons, New York	1984
14	Carrier System Design	Carrier Corporation	Carrier Air Conditioning Co. Syracuse, New York	1972
15	Control Systems for HVAC&R Controls	Roger W Haines	Van Nostrand Reinhold Co. New York, USA	3rd
16	Refrigeration & Air Conditioning	Richard C.Jordan Gayle B. Priester	Prentice-Hall Inc. Englewood Cliffs, New Jersey, USA	2nd1974 1984
17	Refrigeration & Air Conditioning	W.F. Stoecker	McGraw-Hill Book Company Ltd	1984
18	ASHRAE Hand Book, 1977 Fundamental (S.I. Version)	ASHRAE	ASHRAE Inc., 345 East, 47th Street, New York, USA	1977
19	ASHRAE Hand Book, 1986 Refrigeration systems & Applications (S.I. Version)	ASHRAE	ASHRAE Inc., 345 East, 47th Street, New York, USA	1986
20	ASHRAE Handbook Equipment	ASHRAE	ASHRAE Inc., 345 East, 47th Street, New York, USA	1988
21	Thermal Engineering	R.S. Khurmi J.K. Gupta	S.Chand & Company Ltd., New Delhi, India	1977
22	Carrier Hand Book	Carrier Corporation	McGraw Hill Book Co., London/Carrier Aircondiitoning Co. Syracus, New York, USA.	1965

23	Heat Engines	David A. Low	National Book Foundation, Pakistan	1963
24	App. Thermodynamics for Engineers	Eastops T.D. Meconkey	Longman London	6th Edition
25	Basic Air conditioning	Schmaltzier; Gerald & Eveling	Hiayden Book Co., Inc., USA	1971
26	Refrigeration & Air-conditioning (SI Version)	W.F. Stoecker J.W. Jones	McGraw-Hill Int. 2nd Edition	1982
27	Refrigeration & Air-conditioning (SI Version)	R.S. Khurmi J.K. Gupta	Eurasia Publishng House (Pvt) Ltd., Delhi	1998
28	Heat Pumps (Theory and Servicer)	Lee Miles	Delmar Publishers Inc.	-
29	Modern Refrigeration and Air Conditioning (Laboratory Manual)	Althouse / Turnquist / Brucciano	Goodheart Willcox Company, Inc. South Holland, Illinois.	1982
30	1st year Engineering Drawing	A.C. Parkinson	Pitman, London.	1955
31	Building Construction	Arrora	Tata McGraw Hill Company, Delhi	1977
32	Simulator Training Program (User's and Instructor's Manual)	Simutech Multiuser Version 1.0x	Simutech	-
33	Heat Transfer in Refrigeration Materials and Calculations (Manual)	A.L. Jagru Rauf Ahmed Khan	Ministry of Education, Isl.	1987
34	Industrial Refrigeration Machines and Equipment (Manual)	Rahid Ahmed Shakir Zaidi	Ministry of Education, Isl.	1985