

Mgm-311 INDUSTRIAL MANAGEMENT AND HUMAN RELATIONS.

Total Contact Hours	T	P	C
Theory 32	1	0	1

AIMSThe study of this subject will enable the student to develop the management skill, acquaint him with the principles of management and human relations and develop psychological approach to solve the labour problems.

COURSE CONTENTS

- 1. INDUSTRIAL PSYCHOLOGY. 2 Hours**
 - 1.1 History and definition.
 - 1.2 Nature and scope.
- 2. LEADERSHIP 1 Hour**
 - 2.1 Definition and types.
 - 2.3 Qualities of a good leader.
- 3. MOTIVATION 2 Hours**
 - 3.1 Definition.
 - 3.2 Types (Financial and non financial motives).
 - 3.3 Conflict of motives.
- 4. MORALE 1 Hour**
 - 4.1 Importance.
 - 4.2 Development.
 - 4.3 Measurement.
- 5. HUMAN ENGINEERING. 1 Hour**
 - 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. 2 Hours**
 - 6.1 Definition and distinction.
 - 6.2 Psychological causes.
 - 6.3 Objective causes.
 - 6.4 Prevention
- 7. INDUSTRIAL ACCIDENTS 2 Hours**
 - 7.1 Psychological causes.
 - 7.2 Objective causes.

7.3	Prevention	
8.	INDUSTRIAL PREJUDICE	2 Hours
8.1	Causes	
8.2	Remedies	
9.	PUBLIC RELATIONS.	2 Hours
9.1	Importance	
9.2	Functions	
10.	GUIDANCE AND COUNSELLING	2 Hours
10.1	Importance	
10.2	Choice of job.	
10.3	During service.	
11.	JOB EVALUATION	2 Hours
11.1	Importance	
11.2	Methods	
11.3	Job satisfaction	
11.4	Work simplification.	
12.	INDUSTRIAL MANAGEMENT	2 Hours
12.1	Introduction	
12.2	Functions of management.	
12.3	Subdivisions of management	
12.4	Objectives of industrial management.	
13.	PERSONNEL SELECTION.	2 Hours
13.1	Recruitment of employees.	
13.2	Training.	
13.3	Effects of training on production and product cost.	
14.	WORKING CONDITIONS.	2 Hours
14.1	Importance and consideration.	
14.2	Effects on efficiency and per unit cost.	
15.	TIME AND MOTION STUDY.	3 Hours
15.1	Concept and importance.	
15.2	Sequence of motion study.	
15.3	Principles of motion study.	
15.4	Steps to time study.	
15.5	Determination of operations time.	

- 16. QUALITY CONTROL. 2 Hours**
16.1 Concept and advantages
16.2 Methods.

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

BOOKS RECOMMENDED:

- 1 C.S. Meyers, Industrial Psychology, Oxford University Press, London.
2. Smith Wakley, Psychology of Industrial Behaviors, Mc-Graw Hill, New York.
3. Ghulam Hussain, Nizamat-e-Sanaat Aur Insani Rawabat, Ilmi Kitab Khana, Urdu Bazar, Lahore.
4. Andrew R. Megill, The Process of Management William M New Man.
5. Richard N Omen, Management of Industrial Enterprises.

Mgm-311 INDUSTRIAL MANAGEMENT AND HUMAN RELATIONS.

INSTRUCTIONAL OBJECTIVES

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

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

- 2. KNOW LEADERSHIP.**
 - 2.1 Define leadership.
 - 2.2 Describe types of leadership.
 - 2.3 State qualities of a good leader.

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

- 4. KNOW MORALE.**
 - 4.1 State importance of morale.
 - 4.2 Describe development of morale.
 - 4.3 State the method of measurement of morale.

- 5. UNDERSTAND 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 INDUSTRIAL FATIGUE AND BOREDOM.**
 - 6.1 Define fatigue and boredom.
 - 6.2 Describe psychological causes of fatigue and boredom.
 - 6.3 Describe objective causes of fatigue and boredom.
 - 6.4 Explain measures to prevent fatigue and boredom.

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

- 8. UNDERSTAND INDUSTRIAL PREJUDICE.**

- 8.1 Define prejudice
- 8.2 Explain causes of industrial prejudice.
- 8.3 Explain remedies of industrial prejudice.

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

- 10. UNDERSTAND THE NEED FOR GUIDANCE AND COUNSELLING.**
 - 10.1 State importance of guidance and counselling.
 - 10.2 Explain the role of guidance and counselling in choosing the job.
 - 10.3 Describe help of guidance and counselling during service.

- 11. UNDERSTAND 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 INDUSTRIAL MANAGEMENT.**
 - 12.1 Define management.
 - 12.2 State functions of management.
 - 12.3 Enlist subdivision of management.
 - 12.4 Explain objectives of industrial management.

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

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

- 15. UNDERSTAND TIME AND MOTION STUDY.**
 - 15.1 Explain the concept.
 - 15.2 Describe the importance of work study.
 - 15.3 Explain the sequence of motion study.
 - 15.4 State the principles of motion study.
 - 15.5 Describe the steps for carrying out time study.

15.6 Explain the method of determination of operations time.

16. UNDERSTAND THE METHODS OF QUALITY CONTROL.

16.1 Define quality control

16.2 State the advantages of quality control.

16.2 Explain methods of quality control.

17. UNDERSTAND THE ROLE OF FOREMAN IN AN INDUSTRIAL UNDERTAKING.

17.1 Explain ability of the foreman.

17.2 Enlist duties of foreman.

17.3 Describe functions of foreman as middle management.

Mgm-321 BUSINESS COMMUNICATION

T	P	C
1	0	1

Total contact hours

Theory 32 Hrs.

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

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

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

COURSE CONTENTS

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|---|----------------|
| 1. COMMUNICATION PROCESS. | 6 Hours |
| 1.1 Purposes of communication | |
| 1.2 Communication process | |
| 1.3 Distortions in communication | |
| 1.4 Consolidation of communique | |
| 1.5 Communication flow | |
| 1.6 Communication for self development | |
| 2. ORAL COMMUNICATION SKILLS. | 6 Hours |
| 2.1 Significance of speaking. | |
| 2.2 Verbal and non-verbal messages. | |
| 2.3 Strategic steps of speaking. | |
| 2.4 Characteristics of effective oral messages. | |
| 2.5 Communication Trafficking. | |
| 2.6 Oral presentation. | |
| 3. QUESTIONING SKILLS. | 3 Hours |
| 3.1 Nature of question. | |
| 3.2 Types of questions. | |
| 3.3 Characteristics of a good question. | |
| 3.4 Questioning strategy | |
| 4. LISTENING SKILLS. | 5 Hours |
| 4.1 Principles of active listening. | |
| 4.2 Skills of active listening. | |

- 4.3 Barriers to listening.
- 4.4 Reasons of poor listening.
- 4.5 Giving Feedback.

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

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

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

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

RECOMMENDED BOOKS

1. Sh. Ata-ur-Rehman Effective Business Communication & Report Writing.
2. Ulman J.N. Could JR. Technical Reporting.

Mgm-321 BUSINESS COMMUNICATION.

INSTRUCTIONAL OBJECTIVES

1.UNDERSTAND THE COMMUNICATION PROCESS.

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

2. UNDERSTAND THE PROCESS OF ORAL.

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

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

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

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

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

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

- 5.1 State the significance of interviews.
- 5.2 State the characteristics of interviews.
- 5.3 Explain the activities in an interviewing situation.
- 5.4 Describe the types of interviews.

- 5.5 Explain the interviewing strategy.
- 5.6 Prepare instrument for a structured interview.

6. PREPARE A REPORT OUT-LINE, BASED ON SUBJECT MATTER AND AUDIENCE.

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

7. DEMONSTRATE READING COMPREHENSION.

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

8. UNDERSTAND THE PRINCIPLES OF GROUP COMMUNICATIONS.

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

RACT 314AIR -CONDITIONING SYSTEM DESIGN.

Total Contact Hours:		T	P	C
Theory:96 hours	3	3	4	
Practical:96 hours				

Prerequisites: 1)Principles of Air Card
 2)Principle of Refrigeration

AIMSAt the end of the course, the students will be able to:

Acquire necessary knowledge of system design of air conditioning of all classes of buildings, including load estimation, sizing the air-handling equipment and selection of unit, understand the process of Air conditioning of different buildings like libraries, clean spaces, computer rooms, textile and printing industry etc.

COURSE CONTENTS

- 1. SCOPE AND USE OF AIR CONDITIONING SYSTEM. 6 Hours**
 - 1.1 Scope of Air-conditioning
 - 1.2 Components of Air conditioning system.
 - 1.3 all water (Hydronic) Air conditioning systems.
 - 1.4 All air type air conditioning system.
 - 1.5 Planning, installing, commissioning and operating the HVAC system.

- 2. SELECTION OF OUT SIDE DESIGN CONDITION. 6 Hours**
 - 2.1 Winter design condition.
 - 2.2. Summer design condition.
 - 2.3 Selection of out side condition.

- 3. HEAT STORAGE, DIVERSITY AND STRATIFICATION 9 Hours**
 - 3.1 Storage of heat in building structure.
 - 3.2 Diversity of cooling load.
 - 3.3 Stratification of heat.
 - 3.4 Building transmission losses.
 - 3.5 Thermal storage in building structure.

- 4. COOLING LOAD CALCULATION 12 Hours**
 - a.1 Heat storage effect.
 - a.2 Room heat gain
 - a.3 Conduction through exterior structure.
 - a.4 Conduction through interior structure.
 - b) SOLAR HEAT. 9 Hours

- b.1 Defused or sky radiation.
 - b.2 Direct radiation.
 - b.3 Solar radiation through glass.
 - b.4 Shading device.
 - b.5 Structural shading.
 - b.6 Solar transmission through wall and roofs.
 - b.7 Internal heat gain.
 - b.8 People, light and power load.
 - b.9 Problem solving.
- 5. VENTILATION LOAD 9 Hours**
- 5.1 Infiltration load.
 - 5.2 Exileration load.
 - 5.3 Duct heat gain and leakage.
 - 5.4 Fan and pump heat.
 - 5.5 Temperature swing.
 - 5.6 Summary of commercial cooling load calculation.
- 6. HYDRONIC PIPING SYSTEM 9 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.
- 7. AIR HANDLING UNIT/TERMINAL UNIT 9 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 unit heat unit.
 - 7.7 Cabinet unit heater.
 - 7.8 Selection of terminal unit.
 - 7.9 Fan coil unit (cooling)
 - 7.10 Induction unit (Heating & Cooling)
- 8. SOLAR HEATING AND COOLING SYSTEM 6 Hours**
- 8.1 Solar collectors.
 - 8.2 Storage and distribution system.

- 8.3 Types of solar heating system
- 8.4 Solar cooling system
- 8.5 Sunshine hours.
- 8.6 Collector performance.

9. AIR CONDITIONING SYSTEM

9 Hours

- 9.1 System classification.
- 9.2 All air system.
- 9.3 Single zone system
- 9.4 Reheat system.
- 9.5 Multizone system.
- 9.6 Dual duct system.
- 9.7 Variable air volume system.
- 9.8 Individual Control System

10. AIR CONDITIONING FOR PROCESS & PRODUCTS

12 Hours

- 10.1 Laboratories.
- 10.2 Computer room/Telephone Exchange /TV. Station.
- 10.3 Printing plant.
- 10.4 Clean spaces/Class rooms / Residences
- 10.5 Libraries.
- 10.6 Textile and other Industries.
- 10.7 hospitals & Hotels.

REFERENCE BOOKS

- 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 1977.
- 5. Manufacturing equipment catalogs by Trane or carrier. company

RACT-314AIR-CONDITIONING SYSTEM DESING

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 State heating and cooling source for air-conditioning.
- 1.3 Describe air-distribution system.
- 1.4 Describe the equipment for moving the air or water.
- 1.5 State convector and diffuser.
- 1.6 Explain all water (hydronic) air-conditioning system.
- 1.7 Explain all air type air-conditioning system.
- 1.8 Explain planning, installing, commissioning and operating the HVAC system.

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

- 2.1State outside design condition in term of dry bulb temperature and relative humidity.
- 2.2 Enlist the tables for finding out side design condition.
- 2.3 Explain the selection method for finding out side design condition.

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

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

4.1.UNDERSTANT THE PRINCIPLES OF REFRIGERATION AND AIR CONDITIONING LOAD ANALYSIS

- 4.1.1 Calculate cooling load with basic equations in heat exchange components.
- 4.2.1 Identify different load factor in refrigeration and air-conditioning system.
- 4.3.1 Calculate room heat gain.
- 4.4.1 Calculate conduction through interior structure.

4.2UNDERSTAND THE TRANSMISSION OF HEAT THROUGH SOLAR RADIATION

- 4.2.1 Define sky or difused radiation.
- 4.2.2 Define direct solar radiation.
- 4.2.3 Describe solar radiation through glass.
- 4.2.4Describe the effect of shading devices, for calculating cooling load or heating load.

- 4.2.5 Enlist the method of calculating conduct heat gain through wall and roofs due to solar transmission.
- 4.2.6 Derive the formula for calculating internal heat gain.
- 4.2.7 Calculate the heat gain from people, light and power load.

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

- 5.1 Define infiltration.
- 5.2 Define exfiltration.
- 5.3 State duct heat gain and leakage.
- 5.4 State fan and pump heat.
- 5.5 Define temperature swing.
- 5.6 Explain the method of commercial cooling load calculation.
- 5.7 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.

7. UNDERSTAND THE FUNCTION OF AIR HANDLING UNIT/TERMINAL UNIT.

- 7.1 State the function of air-handling unit.
- 7.2 Enlist the types of terminal unit.
- 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 unit heat unit.
- 7.8 Explain the function of cabinet unit heater.
- 7.9 Enlist the method of selecting terminal unit.
- 7.10 Explain the function of induction unit.

8. UNDERSTAND THE SOLAR HEATING AND COOLING SYSTEM..

- 8.1 Define solar heating and cooling system.
- 8.2 Describe solar collectors.
- 8.3 State storage and distribution system.
- 8.4 Enlist the types of solar heating system.

- 8.5 Explain solar cooling system.
- 8.6 State solar radiation energy.
- 8.7 Calculate the collector performance.
- 8.8 Explain sunshine hours.
- 8.9 Describe the method of sizing of collectors.

9. UNDERSTAND THE AIR-CONDITIONING SYSTEM

- 9.1 Enlist the different types of air-conditioning system.
- 9.2 Describe all air system.
- 9.3 Describe single zone system.
- 9.4 Explain reheat system.
- 9.5 Explain single zone system.
- 9.6 Explain multizone and dual duct system.
- 9.7 Explain variable air volume (VAV) system.
- 9.8 Explain all water and air water system.
- 9.9 Describe unitary versus central system.
- 9.10 Explain the Individual control system

10. UNDERSTAN AIR CONDITIONING OF PROCESS AND PRODUCTS FOR DIFFERENT TYPE OF INDUSTRIAL BUILDINGS

- 10.1 Explain planning and designing of air-conditioning system for laboratories.
- 10.2 Explain planning and designing of air-conditioning system for computer rooms/Telephone Exchange/TV.Station.
- 10.3 Explain planning and designing of air-conditioning system for printing plant.
- 10.4 Explain planning and designing of air-conditioning system for clean spaces, libraries/Class room/Residences
- 10.5 Explain air conditioning systems for textile/Chemical industry.
- 10.6 Explain planning and designing of air-conditioning system for Hospitals and hostels.

RACT-314:AIR-CONDITIONING SYSTEM DESIGN

LIST OF PRACTICAL

96 HOURS

- 1- Practice of problem solving on heatload and cooling load.
- 2- Visit of a air conditioning plant to study its components.
- 3- Practice of Estimation and cost calculation
- 4- Practice of problem solving on ventilation load.
- 5- Practice of installation; of Ducts
- 6- 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 fixed absorption system
 - iii. Direct fired absorption system
- 7- Preparation of visit reportS consisting the function of different components, Enlist the type of refrigerant and its percentage used. Temperature control devices used. Types of air handling units, fan coil units, and terminal units used.
- 8- Practice on the installation of air conditioning plant. servicing and maintenance practice during summer vacations.
- 9- Practice of problem solving on airconditioning system design.
10. Study reports on planning and esigning of Air-conditioning systems of Laboratory, computer Lab(room), Printing Plant, Textile or Chemical Industry and Hospital (at least five in number).

RACT 322 WATER AND AIR DISTRIBUTION

Total Contact Hours		T	P	C	
Theory	64 hours		2	0	2

Pre-requisites.

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

AIMSAt the end of the course the students will be able to:

- (i) 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, blowers water and air filtration and treatment, duct and pipe design.

1.1 CONDENSERS AND CONDENSER LOAD 8 Hours

- 1.1.1 Condenser Capacity.
- 1.1.2 Function of condenser.
- 1.1.3 Calculation of condenser capacity.
- 1.1.4 Quantity and temperature rise of condenser media (air and water).
- 1.1.5 Air cooled condenser, air quantity and velocity.
- 1.1.6 Water cooled condenser, water quantity and velocity..
- 1.1.7 Rating and selection of air and water cooled condensers.
- 1.1.8 Evaporative condensers.

1.2 COOLING TOWERS

- 1.2.1 Cooling Towers.
- 1.2.2 Types of Cooling Towers.
- 1.2.3 Cooling Tower Design.
- 1.2.4 Rating and Selection of cooling towers.

2. FUNDAMENTALS OF WATER TREATMENT. 5 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. 7 Hours

- 3.1 Aeration and deaeration.
- 3.2 Distillation and neutralization.

- 3.3 Organic and inorganic 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. 8 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 .
 - 4.6 Centrifugal and axial Fan performance.
 - 4.7 Fan velocity and pressure.
 - 4.8 Fan HP and efficiency.
 - 4.9 Fan total pressure.
 - 4.10 Fan static pressure.
 - 4.11 Selection of fan.
- 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. METHODS OF DUCT DESIGNING 10 Hours**
- 6.1 Equal friction method.
 - 6.2 Velocity method.
 - 6.3 Static Regain method.
 - 6.4 Single and dual duct system.
 - 6.5 Noise attenuation in ducts.
- 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.
 - 9.5 Types of valves and strainers.
 - 9.6 Selection of valves & strainers
 - 9.7 Pipe insulation.
 - 9.8 Pipe installation.
 - 9.10 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. Trane Refrigeration manual.
- 5. Refrigeration, Air conditioning and Cold Storage by Gunther.
- 6. ASHRAE Handbook, Fundamentals Volume.

RACT 322 WATER AND AIR DISTRIBUTION

INSTRUCTIONAL OBJECTIVES:

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

1.1 UNDERSTAND THE CONDENSERS AND CONDENSER LOAD CALCULATIONS.

- 1.1.1 Define condenser.
- 1.1.2 Explain the function of condenser.
- 1.1.3 Calculate condenser capacity.
- 1.1.4 Explain quantity and temperature size of condenser media (air and water).
- 1.1.5 Explain air cooled condenser, air quantity and velocity.
- 1.1.6 Explain water cooled condenser, water quantity and velocity..
- 1.1.7 Explain rating and selection of air and water cooled condensers.
- 1.1.8 Explain evaporative condensers.

1.2 UNDERSTAND THE COOLING TOWERS.

- 1.2.1 Define Cooling towers.
- 1.2.2 Explain Types of Cooling Towers.
- 1.2.3 Explain Cooling Tower Design.
- 1.2.4 State Rating and Selection of cooling towers.

2. UNDERSTAND THE FUNDAMENTALS OF WATER TREATMENT.

- 2.1 State the use and importance of water treatment in air conditioning system.
- 2.2 Analyse Water prior to its 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 inorganic 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. KNOW 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 .
 - 4.6 Describe Centrifugal and Axial Fan performance.
 - 4.7 Define Fan velocity and pressure.
 - 4.8 Define Fan HP and efficiency.
 - 4.9 State Fan total pressure.
 - 4.10 State Fan static pressure.
 - 4.11 State Selection of fan.

- 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. UNDERSTAND THE METHODS OF DUCT DESIGNING.**
 - 6.1 Enlist the method of duct design.
 - 6.2 Explain velocity reduction method.
 - 6.3 Explain equal friction method.
 - 6.4 Explain static regain methods.
 - 6.5 describe single and dual system.
 - 6.6 Discuss noise attenuation in duct.

- 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.

RACT 334 CONTROL AND INSTRUMENTATION

T	P	C
3	3	4

Total contact hours:

Theory - 96 hours
Practical - 96 hours

Pre-requisites: (i) Fundamentals and Principles of Refrigeration Heating, Ventilating and Air-conditioning.
(ii) Workshop practice.

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

- (i) Understand the principles of selection, installation and operation of various types of Electrical, Electronic pneumatic, Electro-mechanical and Electro-pneumatic controls
- (ii) Understand the operation of control elements, such as sensors, controllers, actuators and related accessories
- (iii) 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 Process plant
 - 1.2.5 Controlled variable
 - 1.2.6 Control medium
 - 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 Diagram
 - 1.3. Basic Functions of parts
 - 1.3.1 Controllers
 - 1.3.2 Sensors
 - 1.3.3 Actuators
 - 1.3.4 Accessories
 - 1.4. Safety Controls

2.	CONTROL SYSTEMS/ACTIONS	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 CONTROLS	3 Hours
3.1	Thermostat and its types	
3.2	Thermocouple	
3.3	Electrical Resistance	
3.4	Bi-metal	
4.	HUMIDITY CONTROLS	3 Hours
4.1	Hygroscopic Humidistat	
4.2	Electrical Humidistat	
4.3	Electronic Humidistat	
4.4	Photoelectric sensor type Humidistat	
5.	PRESSURE CONTROL ELEMENTS	2 Hours
5.1	Bellows	
5.2	Diaphragm	
5.3	Bourdon Tube	
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 Operators	
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

8. ELECTRIC CONTROL 6 Hours

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

9. ELECTRONIC CONTROLS 10 Hours

- 9.1 Electronic controls and its advantages
- 9.2 Electronic control Components:
 - 9.2.1 Diodes
 - 9.2.2 Transducers
 - 9.2.3 Transistors
 - 9.2.4 Rectifiers
 - 9.2.5 Amplifiers
 - 9.2.6 Potentiometer
 - 9.2.7 Thermistor
- 9.3 Conductivity Controller
- 9.4 pH Controller

10. PNEUMATIC CONTROLS 6 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 1 Hour

- 11.1 Automatic Expansion Valve
- 11.2 Thermostatic Expansion Valve

12. CONTROL APPLICATIONS 1 Hour

- 12.1 Individual Control
- 12.2 Single Zone Control

12.3 Multi-zone control

13. ELECTRIC CONTROL CIRCUITS 9 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 MANAGEMENT SYSTEM 8 Hours

- 14.1 Introduction of Building Management System (BMS)
- 14.2 Microprocessor based digital control and its advantages
- 14.3 Study the microprocessor controller and its programming
- 14.4 Understanding logics
- 14.5 Data generation of building management system

15. MAINTENANCE 7 Hours

- 15.1 Maintenance and calibration of various control systems
- 15.2 Preparation of Maintenance 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 12 Hours

- 16.1 Pressure Gauges
- 16.2 Vacuum Gauges
- 16.3 Compound gauges

- 16.4 Thermometers
 - 16.4.1 Pipe line Thermometers
 - 16.4.2 Duct Thermometers
- 16.5 Flow Recorders
- 16.7 Pressure Recorders
- 16.8 Temperature Recorders
- 16.9 Temperature and Flow recorders
- 16.10 Velocity Meters
- 16.11 Manometers
- 16.12 pH meters
- 16.13 Conductivity Meters
- 16.14 Flue Gas Analyzer
- 16.15 Electronic Leak detectors

Recommended Books:

1. Automatic Controls of Heating and Air-conditioning by John E. Haines
2. ASHRAE Hand Book- Application & Equipment Volume
3. Control Manual by Ministry of Education, Islamabad.
4. Automatic Controls (HVAC) by Abdul Majid Khan

RACT 334 CONTROL 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 Describe Process plant, 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, Timed 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**
 - 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 CONTROLS**
 - 4.1 Define Hygroscopic Humidistat
 - 4.2 Define Electrical Humidistat
 - 4.3 Define Electronic Humidistat
 - 4.4 Explain Photoelectric sensor type Humidistat
- 5. KNOW THE FUNCTION AND USE OF PRESSURE CONTROL ELEMENTS**
 - 5.1 Describe Bellows

- 5.2 Describe Diaphragm
- 5.3 Describe Bourdon Tube

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

- 6.1 Describe Float Valve
- 6.2 Describe 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 Operators
 - 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

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 FUNCTION AND THE USE OF ELECTRONIC CONTROLS

- 9.1 Describe Electronic controls and its advantages
- 9.2 Explain Electronic control Components:
 - 9.2.1. Describe Diodes, Transducers, Transistors, Rectifiers, Amplifiers, Potentiometer, and Thermistor
- 9.3 Explain Conductivity Controller
- 9.4 Explain 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

- 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 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 CENTRALLY COMPUTERIZED CONTROLLED BUILDING MANAGEMENT SYSTEMS**
 - 14.1 Explain Building Management System (BMS)
 - 14.2 Explain Microprocessor based digital control 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

- 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 Describe Pressure Gauges, Vacuum Gauges, Compound Gauges
- 16.2 Explain Thermometers, Pipe line Thermometers, Duct Thermometers
- 16.3 Describe Flow Recorders, Pressure Recorders, Temperature Recorders, Temperature and Flow recorders
- 16.4 Explain Velocity Meters
- 16.5 Explain Manometers
- 16.6 Define pH meters, Conductivity Meters
- 16.7 Explain Flue Gas Analyzer, Electronic Leak detectors

Recommended Books:

1. Automatic Controls of Heating and Air-conditioning by John E. Haines
2. ASHRAE Hand Book- Application & Equipment Volume
3. Control Manual by Ministry of Education, Islamabad.
4. Automatic Controls (HVAC) by Abdul Majid Khan

RACT 334 CONTROL AND INSTRUMENTATION

LIST OF PRACTICALS

96 HOURS

1. Checking and testing of thermostats
2. Checking and testing of Humidistats
3. Checking and testing of Timer and Defrost heaters
4. Checking and testing of Solenoid Valves
5. Checking and testing of Single phase motors
6. Checking and testing of Three phase motors
7. Checking and testing of Single phase magnetic contactors
8. Checking and testing of Three phase magnetic contactors
9. Checking and testing of Automatic Direct on line starter
10. Checking and testing of Automatic Star-Delta starter
11. Checking and testing of motorized valves
12. Checking and testing of damper motors (Electric, Electronics & Pneumatic)
13. Sketch two wire control circuits
14. Sketch three wire control circuits
15. Draw multi-position control circuits
16. Sketch floating control circuits
17. Installation of louvers type dampers
18. Sketch basic Wheat Stone Bridge circuits
19. Prepare the proportional system with time relay adjustment.
20. Study the set point adjustment integral with the space thermostat
21. Study the Differential adjustment in different thermostats
22. Study the sequence hook-up using programme strip
23. Study the elements of typical pneumatic system
24. Study different types of recorders (Temperature, Flow, Humidity etc.)
25. Study the use of water balancing instruments such as pressure gauges, thermometers, flow indicators etc.
26. Study the use of air balancing instruments such as velocity meter, manometer etc.
27. Analysis of multi-storey commercial/industrial buildings for zoning.
28. Visit to commercial/industrial buildings to study the application and circuit diagram of different controls used in HVAC&R Systems.

RACT 342 INDUSTRIAL REFRIGERATION AND AIR CONDITIONING MACHINES & EQUIPMENT

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

Pre-requisite.

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

AIMS At the end of the course the student will be able to:

1. Know 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 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. 4 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. 10 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 humidifying.
- 3.6 Applications of Air washers.

- 3.7 Problem Solving
- 4. CENTRIFUGAL AIR CONDITIONING SYSTEM 10 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 refrigeration chillers.
- 4.5 Application of Centrifugal Chillers.
- 5. COMMERCIAL AIR CONDITIONING SYSTEM. 14 Hours**
- 5.1 Types of commercial Air-conditioning systems.
- 5.2 Centrally air conditioning system and equipment (Water Chillers, Boilers, Cooling Towers, AHUs, FCUs, VAV Units, Circulating Pumps, Heat Exchangers, Air Separators, Compression Tank etc.) .
- 5.3 Flow Diagram of Centrally Air-conditioning System.
- 5.4 Packaged units.
- 5.5 Roof-top Units
- 5.6. Split units.
- 5.7 Multi-evaporator (mini) split system
- 5.8 Electrical circuit diagram of packaged units.
- 5.9 Electrical circuit diagram of split units.
- 6. HUMIDIFIERS AND DEHUMIDIFIERS. 8 Hours**
- 6.1 Purpose of Humidifiers and Dehumidifiers (Residential & Industrial).
- 6.1 Types of Humidifiers
- 6.2 Types of Dehumidifiers.
- 6.3 Working principles and construction detail of Humidifiers and Dehumidifiers .
- 7. ICE PLANTS. 6 Hours**
- 7.1 Commercial ice plant (Reciprocating vapor compression system using Ammonia as Refrigerant).
- 7.2 Construction Detail of Refrigeration cycle of ice plant.
- 7.3. Cooling Load Calculations.

REFERENCE BOOKS

1. Train Air-conditioning manual.
2. Modern Refrigeration and Air-conditioning by Althouse.
3. ASHRAE Handbook- Fundamental Volume 1977.
4. Principles of Air conditioning by Pita

RACT 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 State 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 Describe Types of air washers
- 3.3 Process Air washer computations.
- 3.4 Explain Cooling and humidification.
- 3.5 Explain Heating and humidifying.
- 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 State off-and-on control.
- 4.7 Describe hot gas by pass control, condenser water regulation, Butterfly dampers, speed control, variable inlet, guide inlets.
- 4.8 Describe the application of Centrifugal chillers.

5. UNDERSTAND DIFFERENT TYPES OF COMMERCIAL AIR CONDITIONING SYSTEM.

- 5.1 Describe the Types of commercial Air-conditioning systems.
- 5.2 Explain the Centrally air conditioning system and equipment (Water Chillers, Boilers, Cooling Towers, AHUs, FCUs, VAV Units, Circulating Pumps, Heat Exchangers, Air Separators, Compression Tank etc.) .
- 5.3 Draw Flow Diagram of Centrally Air-conditioning System.
- 5.4 Describe Packaged units.
- 5.5 Describe Roof-top Units
- 5.6. State Split units.
- 5.7 Explain Multi-evaporator (mini) split system
- 5.8 Draw Electrical circuit diagram of packaged units.
- 5.9 Draw Electrical circuit diagram of split units.

6. UNDERSTAND THE DIFFERENT TYPES OF HUMIDIFIERS AND DEHUMIDIFIERS.

- 6.1 State the Purpose of Humidifiers and Dehumidifiers (Residential & Industrial).
- 6.1 Explain the Types of Humidifiers (pan, pad and atomizing type)
- 6.2 Explain the Types of Dehumidifiers. (Cooling Coil and Chemical)
- 6.3 State the Working principles and construction detail of Humidifiers and Dehumidifiers.

7 UNDERSTAND THE ICE PLANTS

- 7.1 Describe the Commercial ice plant (Reciprocating vapor compression system using Ammonia as Refrigerant).
- 7.2 Explain Construction Detail of Refrigeration cycle of ice plant.
- 7.3. Calculate the Cooling Load Capacity of ice plant.

RACT 352 TECHNICAL PROJECT

Total contact hours	T	P	C
Practical 192 hours	0	6	2

Prerequisites. All subject studied in 2nd year.

AIMSThe student will be able to:

1.The knowledge gained in several courses applies it to practice.

2. Design HVAC system.

 This course consists entirely of projects.

RECOMMENDED LIST OF PROJECTS:

- 1.Design and Equipment Selection of Central Air-conditioning for High rise multistore Commercial Building
2. Design and Equipment Selection of Central Air-conditioning for Departmental Store.
- 3.Design and Equipment Selection of Central Air-conditioning for Computer Room/Testing Laboratories/Clean Spaces.
4. Design and Equipment Selection of Central Air-conditioning for Industrial Building:
 - i) Electronic Manufacturing Company
 - ii) Textile Mill
5. Design and Equipment Selection of Central Air-conditioning for Cinema House
6. Design and Equipment Selection of Central Air-conditioning for Hospital.
7. Design and Equipment Selection of Central Air-conditioning for Hotel/ Cafeteria.
- 8.Design and Equipment Selection of Refrigeration Plant for cold storage for meat, vegetables and fruits.

Note: Project Report for above said projects should contain the following information as given below:

1. Cover.
2. Title page.
3. Statement and project.
4. Building tracing/drawing.
5. Design criteria.
6. Heating and cooling load calculations.
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. Humidifiers (if requires)
 - k. Control valves.
 - l. Thermostats.
- 12. Schematic Control System
 - 13. Working drawings including 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.

REFERENCE BOOKS

- 1 Air Conditioning Principles and System by E.G.PITA.
- 2 Principles of Refrigeration by Dossat.
- 3 System Design manual by Carrier.
- 4 ASHRAE. Handbook - Fundamental & Equipment Volume.
- 5 Manufacturing equipment catalogs by Trane /York/Mitsubishi/ Goldstar/ Hitachi/ SKM/Carrier company/Crane/Trox.

RACT 363 HEAT TRANSFER AND REFRIGERATION CALCULATIONS

TOTAL CONTACT HOURS		T	P	C
Theory 96 hours	3	0	3	

Prerequisites.

1. Fundamentals of math.

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 condenser.

1. METHODS OF HEAT TRANSFER. 12 Hours

- 1.1 Introduction of 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 Problem Solving related to Heat Transfer through conduction

2.DETERMINATION OF OVER ALL CO-EFFICIENT OF HEAT TRANSMISSION FACTOR. 12 hours

- 2.1 Thermal conductivity of materials.
- 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 by 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 12 Hours

- 3.1 Heat transfer factor in equipment.
- 3.2 Fluid factor.
- 3.3 Tube factor
- 3.4 Temperature factor.
- 3.5 Surface factor
- 3.6. Designing factor.
- 3.7 Heat surface area calculation.
- 3.8 Resultant Temperature.
- 3.9 Common window glass
- 3.10 Shade glass
- 3.11 Other types of glass

- 3.12 Glass Blocks.
- 3.13 Heat gain through glass.
- 3.14 Problem Solving

4. CYCLE DIAGRAM OF SIMPLE SATURATED CYCLE. 15 Hours

- 4.1 Cycle diagram.
- 4.2 Introduction of ph chart
- 4.3 Simple saturated cycle on pressure enthalpy diagram
- 4.4 Expansion process.
- 4.5 Vaporizing process
- 4.6 Compression process.
- 4.7 Condensing process.
- 4.8 Tracing of simple saturated cycle on Pressure Enthalpy Chart (ph diagram) for R-12 and R-22
- 4.9 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.
- 4.10 Problem Solving on ph chart.

5. ACTUAL REFRIGERATION CYCLE. 12 Hours

- 5.1 Heat Exchanger
- 5.2 The effect of super heat on 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 Tracing of simple saturated cycle on Pressure Enthalpy Chart (ph diagram) for R-12 and R-22
- 5.8 Solving of problems on ph chart

**6. PERFORMANCE/EFFICIENCY OF REFRIGERATION CYCLE (HEAT PUMP)
15 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 Refrigeration Cycle
- 6.7 Drawing of multistage refrigeration cycle on ph diagram.
- 6.8 Solving of problems of multistage refrigeration cycle on ph chart for R-12 and R-22.

7. SIZING AND SELECTION OF CONDENSER, COOLING COIL AND

REFRIGERANT LINES**12 Hours**

- 7.1 Sizing and selection of Hot vapor line (Discharge line)
- 7.2 Sizing and selection of Condenser
- 7.3 Sizing of liquid line
- 7.4 Liquid indicator and sight glass.
- 7.5 Sizing and selection of Expansion valve.
- 7.6 Sizing and Selection of cooling coil in term of heat contents.
- 7.7 Selection of suction line.
- 7.8 Solving problems on condensers and cooling coils.

8. CLEANING SOLVENT/DESCALER.**6 Hours**

- 8.1 Purpose of solvent
- 8.2 Kind of solvent.
- 8.3 Dissolvents
- 8.4 Fuel and combustion.

REFERENCE BOOKS:

- 1. Principle of Refrigeration by R.J. Dossat.
- 2. Refrigeration, Air-conditioning & Cold storage by R.C.Gunthor.
- 3. Manual of Heat Transfer by Ministry of Education.
- 4. ASHRAE Handbook- Fundamental & Equipment Volume

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 Solve Problems related to Heat Transfer through conduction

2.DETERMINE OVER ALL CO-EFFICIENT OF HEAT TRANSMISSION FACTOR.

- 2.1Define Thermal conductivity of material.
- 2.2 Define Thermal conductance of material.
- 2.3 Define Thermal resistance of material.
- 2.4 Determine the "U" factor by calculation.
- 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. UNDERSTAND THE PROPERTIES OF INSULATORS AND CONDUCTORS.

- 3.1 Explain Heat transfer factor in equipment.
- 3.2Define Fluid factor,Tube factor, Temperature factor, Surface factor and Designing factor.
- 3.3 Calculate Heat surface areas.
- 3.4Define Resultant Temperature.
- 3.5 Explain Common window glass
- 3.6Describe Shade glass
- 3.7 Describe Other types of glass
- 3.8 Explain Glass Blocks.
- 3.9Describe Heat gain through glass.
- 3.10 Solve Problems.

4. UNDERSTAND THE CYCLE DIAGRAM OF SIMPLE SATURATED CYCLE.

- 4.1 Explain Cycle diagram.
- 4.2 Explain ph chart
- 4.3 Explain Simple saturated cycle on pressure enthalpy diagram
- 4.4State Expansion process, Vaporizing process, Compression process and Condensing process.
- 4.5Trace a simple saturated cycle on Pressure Enthalpy Chart (ph diagram) for R-12

and R-22

- 4.6 Determine the 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 by calculations.
- 4.10 Solve Problems on ph chart.

5. UNDERSTAND THE ACTUAL REFRIGERATION CYCLE.

- 5.1 Explain Heat Exchanger
- 5.2 Describe the effect of super heat on 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 Trace a simple saturated cycle on Pressure Enthalpy Chart (ph diagram) for R-12 and R-22
- 5.8 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 Refrigeration Cycle
- 6.7 Draw a multistage refrigeration cycle on ph diagram.
- 6.8 Solve problems of multistage refrigeration cycle on ph chart for R-12 and R-22.

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.
- 7.5 Explain the procedure for Sizing and Selection of cooling coil in term of heat contents.
- 7.6 Explain the procedure for Selection of suction line.
- 7.7 Solve problems on condensers and cooling coils.

8. UNDERSTAND THE CLEANING METHODS BY SOLVENT/DESCALER.

- 8.1 Explain the purpose of solvent
- 8.2 Enlist the kinds of solvents.
- 8.3 Enlist the Dissolvents
- 8.4 Explain the fuels and combustion.

LIST OF PRACTICALS**288 hours**

1. Split air conditioners circuit diagram.
2. Installation of split air conditioning system
3. Packaged air conditioner circuit diagram.
4. Installation of package air conditioner
 - (a) Air-cooled
 - (b) Water cooled.
5. Wiring of packaged air conditioner with forced air cooling tower and circulating pump
6. Repair and maintenance of commercial air conditioning units.
7. Determination of cooling tower range and approach and its performance.
8. Servicing and repair of cooling towers.
9. Internal circuit of room temperature motor control
10. Internal wiring of single phase and three phase generators.
11. To make circuit diagram for air washer including centrifugal fans, humidity control and circulating water pumps.
12. Heating and humidifying with a pre-heat air washers and reheat coil.
13. Installation of hydronic terminal units (heating and cooling)
14. To make circuit diagram for Air conditioning system with central fan, spray type humidifier, Direct Expansion (DX) refrigeration coils, filters, ducts, compressor, Steam /water heating coil and controls.
15. Centrifugal pumps overhauling and alignment
16. To make circuit flow diagram of chilled/hot water air conditioning system.
17. Visits to different air-conditioning plants for above practicals.