HINDUSTAN UNIVERSITY
HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE
(Estd. u/s 3 of the UGC Act, 1956)
Padur, Kancheepuram District - 603 103.

DEPARTMENT OF
MECHANICAL ENGINEERING

Regulations Curriculum and Syllabus 2013

M.Tech.
REFRIGERATION AND AIR-CONDITIONING

ACADEMIC REGULATIONS
(M.TECH./ M.B.A. / M.C.A.) (Full - Time / Part - Time)
(Effective 2013-14)

1. Vision, Mission and Objectives

1.1 The Vision of the Institute is "To make every man a success and no man a failure".

In order to progress towards the vision, the Institute has identified itself with a mission to provide every individual with a conducive environment suitable to achieve his / her career goals, with a strong emphasis on personality development, and to offer quality education in all spheres of engineering, technology, applied sciences and management, without compromising on the quality and code of ethics.

1.2 Further, the institute always strives

- To train our students with the latest and the best in the rapidly changing fields of Engineering, Technology, Management, Science & Humanities.
- To develop the students with a global outlook possessing, state of the art skills, capable of taking up challenging responsibilities in the respective fields.
- To mould our students as citizens with moral, ethical and social values so as to fulfill their obligations to the nation and the society.
- To promote research in the field of science, Humanities, Engineering, Technology and allied branches.

1.3 Our aims and objectives are focused on

- Providing world class education in engineering, technology, applied science and management.
- Keeping pace with the ever changing technological scenario to help our students to gain proper direction to emerge as competent professionals fully aware of their commitment to the society and nation.
- To inculcate a flair for research, development and entrepreneurship.

2. Admission

2.1 The admission policy and procedure shall be decided from time to time by the Board of Management (BOM) of the Institute, following guidelines issued by Ministry of Human Resource Development (MHRD), Government of India. The number of seats in each branch of the (M.TECH / M.B.A. / M.C.A.) programme will be decided by BOM as per the directives from Ministry of Human Resource Development (MHRD), Government of India and taking into account the market demands. Some seats for Non Resident Indians and a few seats for foreign nationals shall be made available.

2.2 The selected candidates will be admitted to the (M.TECH / M.B.A. / M.C.A.) programme after he/she fulfills all the admission requirements set by the Institute and after payment of the prescribed fees.

2.3 Candidates for admission to the first semester of the Master's Degree Programme shall be required to have passed an appropriate Degree Examination recognized by Hindustan University.

2.4 In all matters relating to admission to the (M.TECH / M.B.A. / M.C.A.). Programme, the decision of the Institute and its interpretation given by the Chancellor of the Institute shall be final.

2.5 If at any time after admission, it is found that a candidate has not fulfilled any of the requirements stipulated by the Institute, the Institute may revoke the admission of the candidate with information to the Academic Council.

3. Structure of the programme

3.1 The programme of instruction will have the following structure

i) Core courses of Engineering / Technology / Management.

ii) Elective courses for specialization in areas of student's choice

3.2 The minimum durations of the programmes are as given below:

Program	No. of Semesters
M.Tech.(Full-Time)	4
M.Tech.(Part -Time)	6
M.B.A. (Full - Time)	4
M.B.A. (Part - Time)	6
M.C.A.(Full - Time)	6
M.C.A.(Part -Time)	8

Every (M.TECH / M.B.A. / M.C.A.) programme will have a curriculum and syllabi for the courses approved by the Academic Council.

3.3 Each course is normally assigned certain number of credits. The following norms will generally be followed in assigning credits for courses.

- One credit for each lecture hour per week per semester
- One credit for each tutorial hour per week per semester
- One credit for each laboratory practical of three hours per week per semester.
- One credit for 4 weeks of industrial training and
- One credit for 2 hours of project per week per semester.

3.4 For the award of degree, a student has to earn certain minimum total number of credits specified in the curriculum of the relevant branch of study. The curriculum of the different programs shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below.

Program	Minimum prescribed credit range
M.Tech. (Full time / Part time)	75 - 85
M.B.A. (Full time / Part time)	85 - 95
M.C.A (Full time / Part time)	115 - 125

3.5 The medium of instruction, examination and the language of the project reports will be English.

4. Faculty Advisor

4.1 To help the students in planning their courses of study and for getting general advice on the academic programme, the concerned Department will assign a certain number of students to a Faculty member who will be called their Faculty Advisor.

5. Class Committee

5.1 A Class Committee consisting of the following will be constituted by the Head of the Department for each class:

(i) A Chairman, who is not teaching the class.

(ii) All subject teachers of the class.

(iii) Two students nominated by the department in consultation with the class.

The Class Committee will meet as often as necessary, but not less than three times during a semester.

The functions of the Class Committee will include:

(i) Addressing problems experienced by students in the classroom and the laboratories.

(ii) Analyzing the performance of the students of the class after each test and finding ways and means of addressing problems, if any.

(iii) During the meetings, the student members shall express the opinions and suggestions of the class students to improve the teaching / learning process.

6. Grading

6.1 A grading system as below will be adhered to.

Range of Marks	Letter Grade	Grade points
95-100	S	10
85 - 94	A	09
75- 84	B	08
65-74	C	07
55-64	D	06
50-54	E	05
< 50	U	00
	I (Incomplete)	–

6.2 GPA & CGPA

GPA is the ratio of the sum of the product of the number of credits C_i of course "i " and the grade points P_i earned for that course taken over all courses "i" registered by the student to the sum of Ci for all "i ". That is,

$$GPA = \frac{\sum_i C_i P_i}{\sum_i C_i}$$

CGPA will be calculated in a similar manner, at any semester, considering all the courses enrolled from first semester onwards.

6.3 For the students with letter grade I in certain subjects, the same will not be included in the computation of GPA and CGPA until after those grades are converted to the regular grades.

6.4 Raw marks will be moderated by a moderation board appointed by the Vice-Chancellor of the University. The final marks will be graded using an absolute grading system. The Constitution and composition of the moderation board will be dealt with separately.

7. Registration and Enrollment

7.1 Except for the first semester, registration and enrollment will be done in the beginning of the semester as per the schedule announced by the University.

7.2 A student will be eligible for enrollment only if he/she satisfies regulation 10 (maximum duration of the programme) and will be permitted to enroll if (i) he/she has cleared all dues in the Institute, Hostel & Library up to the end of the

previous semester and (ii) he/she is not debarred from enrollment by a disciplinary action of the University.

7.3 Students are required to submit registration form duly filled in.

8. Registration requirement

8.1 **(i)** A Full time student shall not register for less than 16 credits or more than 26 credits in any given semester.

8.1 **(ii)** A part time student shall not register for less than 10 credits or more than 20 credits in any given semester.

8.2 If a student finds his/her load heavy in any semester, or for any other valid reason, he/she may withdraw from the courses within three weeks of the commencement of the semester with the written approval of his/her Faculty Advisor and HOD. However the student should ensure that the total number of credits registered for in any semester should enable him/her to earn the minimum number of credits per semester for the completed semesters.

9. Minimum requirement to continue the programme

9.1 For those students who have not earned the minimum required credit prescribed for that particular semester examination, a warning letter to the concerned student and also to his parents regarding the shortage of his credit will be sent by the HOD after the announcement of the results of the university examinations.

10. Maximum duration of the programme

The minimum and maximum period for the completion of various programs are given below.

Program	Min. No. of Semesters	Max. No. of Semesters
M.Tech (Full - time)	4	8
M.Tech (Part - time)	6	10
M.B.A. (Full Time)	4	8
M.B.A. (Part Time)	6	10
M.C.A. (Full - Time)	6	12
M.C.A (Part -Time)	8	14

11. Temporary discontinuation

11.1 A student may be permitted by the Director(academic) to discontinue temporarily from the programme for a semester or a longer period for reasons of ill health or other valid reasons. Normally a student will be permitted to discontinue from the programme only for a maximum duration of two semesters.

12. Discipline

12.1 Every student is required to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the University.

12.2 Any act of indiscipline of a student reported to the Director (Academic) will be referred to a Discipline Committee so constituted. The Committee will enquire into the charges and decide on suitable punishment if the charges are substantiated. The committee will also authorize the Director(Academic) to recommend to the Vice-Chancellor the implementation of the decision. The student concerned may appeal to the Vice-Chancellor whose decision will be final. The Director (Academic) will report the action taken at the next meeting of the Council.

12.3 Ragging and harassment of women are strictly prohibited in the University campus and hostels.

13. Attendance

13.1 A student whose attendance is less than 75% is not eligible to appear for the end semester examination for that semester. The details of all students who have attendance less than 75% will be announced by the teacher in the class. These details will be sent to the concerned HODs and Director (Academic).

13.2 Those who have less than 75% attendance will be considered for condonation of shortage of attendance. However a condonation of 10% in attendance will be given on medical reasons. Application for condonation recommended by the Faculty Advisor, concerned faculty member and the HOD is to be submitted to the Director (Academic) who, depending on the merits of the case, may permit the student to appear for the end semester examination. A student will be eligible for this concession at most in two semesters during the entire degree programme. Application for medical leave, supported by medical certificate with endorsement by a Registered Medical Officer, should reach the HOD within seven days after returning from leave or, on or before the last instructional day of the semester, whichever is earlier.

13.3 As an incentive to those students who are involved in extra curricular activities such as representing the University in Sports and Games, Cultural Festivals, and Technical Festivals, NCC/ NSS events, a relaxation of up to 10% attendance will be given subject to the condition that these students take prior approval from the officer-in-charge. All such applications should be recommended by the concerned HOD and forwarded to Director (Academic) within seven instructional days after the programme/activity.

14. Assessment Procedure

14.1 The Academic Council will decide from time to time the system of tests and examinations in each subject in each semester.

14.2 For each theory course, the assessment will be done on a continuous basis as follows:

Test / Exam	Weightage	Duration of Test Exam
First Periodical Test*	10%	2 Periods
Second Periodical Test*	10%	2 Periods
Model exam	20%	3 hours
Seminar/ Assignments/Quiz	20%	
End - semester examination	50%	3 Hours

*** Best out of the two tests will be considered.**

14.3 For practical courses, the assessment will be done by the subject teachers as below:

(i) Weekly assignment/Observation note book / lab records - weightage 60%.

(ii) End semester examination of 3 hours duration including viva - weightage 40%

15. Make up Examination/model examination

15.1 Students who miss the end-semester examinations / model examination for valid reasons are eligible for make-up examination /model examination. Those

who miss the end-semester examination / model examination should apply to the Head of the Department concerned within five days after he / she missed examination, giving reasons for absence.

15.2 Permission to appear for make-up examination / model exam will be given under exceptional circumstances such as admission to a hospital due to illness. Students should produce a medical certificate issued by a Registered Medical Practitioner certifying that he/she was admitted to hospital during the period of examination / model exam and the same should be duly endorsed by parent / guardian and also by a medical officer of the University within 5 days.

16. Project evaluation

16.1 For Project work, the assessment will be done on a continuous basis as follows:

Review / Examination	Weightage
First Review	10%
Second Review	20%
Third Review	20%
End semester Examination	50%

For end semester exam, the student will submit a Project Report in a format specified by the Director (Academic). The first three reviews will be conducted by a Committee constituted by the Head of the Department. The end - semester examination will be conducted by a Committee constituted by the Controller of Examinations. This will include an external expert.

17. Declaration of results

17.1 A candidate who secures not less than 50% of total marks prescribed for a course with a minimum of 50% of the marks prescribed for the end semester examination shall be declared to have passed the course and earned the specified credits for the course.

17.2 After the valuation of the answer scripts, the tabulated results are to be scrutinized by the Result Passing Boards of PG programmes constituted by the Vice-Chancellor. The recommendations of the Result Passing Boards will be placed before the Standing Sub Committee of the Academic Council constituted by the Chancellor for scrutiny. The minutes of the Standing Sub Committee along with the results are to be placed before the Vice-Chancellor for approval. After getting the approval of the Vice-Chancellor, the results will be published by the Controller of Examination/ Registrar.

17.3 If a candidate fails to secure a pass in a course due to not satisfying the minimum requirement in the end semester examination, he/she shall register and re-appear for the end semester examination during the following semester. However, the sessional marks secured by the candidate will be retained for all such attempts.

17.4 If a candidate fails to secure a pass in a course due to insufficient sessional marks though meeting the minimum requirements of the end semester examination, wishes to improve on his/ her sessional marks, he/she will have to register for the particular course and

attend the course with permission of the HOD concerned and the Registrar. The sessional and external marks obtained by the candidate in this case will replace the earlier result.

17.5 A candidate can apply for the revaluation of his/her end semester examination answer paper in a theory course within 2 weeks from the declaration of the results, on payment of a prescribed fee through proper application to the Registrar/Controller of Examinations through the Head of the Department. The Registrar/ Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Department. Revaluation is not permitted for practical courses and for project work.

17.6 The weightage for internal marks in finalizing results and grades shall be waived off after completion of 5 semesters.

18. Grade Card

18.1 After results are declared, grade sheet will be issued to each student, which will contain the following details:

(i) Program and branch for which the student has enrolled.

(ii) Semester of registration.

(iii) List of courses registered during the semester and the grade scored.

(iv) Semester Grade Point Average (GPA)

(v) Cumulative Grade Point Average (CGPA).

19. Class / Division

19.1 Classification is based on CGPA and is as follows:

CGPA $\geq$ 8.0 : **First Class with distinction**

$6.5 \leq$ CGPA < 8.0 : **First Class**

$5.0 \leq$ CGPA < 6.5 : **Second Class.**

19.2 (i) Further, the award of 'First class with distinction' is subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses in his/her first appearance within the minimum duration of the programme.

(ii) The award of 'First Class' is further subject to the candidate becoming eligible to the award of the degree having passed the examination in all the courses within the below mentioned duration of the programme.

Program	No. of Semesters
M.Tech.(Full-Time)	5
M.Tech.(Part -Time)	7
M.B.A. (Full - Time)	5
M.B.A. (Part - Time)	7
M.C.A.(Full - Time)	7
M.C.A.(Part -Time)	9

(iii) The period of authorized discontinuation of the programme (vide clause 11.1) will not be counted for the purpose of the above classification.

20. Transfer of credits

20.1 Within the broad framework of these regulations, the Academic Council, based on the recommendation of the transfer of credits committee so constituted by the Chancellor may permit students to earn part of the credit requirement in other approved institutions of repute and status in the country or abroad.

21. Eligibility for the award of (M.TECH / M.B.A. / M.C.A.) Degree

21.1 A student will be declared to be eligible for the award of the (M.TECH / M.B.A. / M.C.A.). Degree if he/she has

i) registered and successfully credited all the core courses,

ii) successfully acquired the credits in the different categories as specified in the curriculum corresponding to the discipline (branch) of his/her study within the stipulated time,

iii) has no dues to all sections of the Institute including Hostels, and

iv) has no disciplinary action pending against him/her.

The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the University.

22. Power to modify

22.1 Notwithstanding all that has been stated above, the Academic Council has the right to modify any of the above regulations from time to time subject to approval by the Board of Management.

Hindustan University

Hindustan Institute of Technology and Science

M.Tech. - Refrigeration And Air-Conditioning

Semester - I

Sl. No.	Course	Course Title	L	T	P	C	TCH
Theory							
1	PMA 101	Advanced Engineering Mathematics	4	0	0	4	4
2	PTE101	Advanced Heat Transfer	4	0	0	4	4
3	PTE102	Advanced Thermodynamics	4	0	0	4	4
4	PTE 104	Instrumentation in Thermal Systems	4	0	0	4	4
5	PRA101	Refrigeration Systems Design	4	0	0	4	4
6	PTE707	Thermal Energy Systems	4	0	0	4	4
PRACTICAL							
7	PRA151	R & AC Lab - I	0	0	3	1	3
		Total				25	27

SEMESTER II

S.No	Course	Course Title	L	T	P	C	TCH
Theory							
1	PRA201	Air-conditioning Systems Design	4	0	0	4	4
2	PRA 202	Computer Simulation of Refrigeration& Air-conditioning Systems	4	0	0	4	4
3	PRA 203	Refrigeration Machinery and Components	4	0	0	4	4
4	-	Elective -I*	4	0	0	4	4
5	-	Elective - II*	4	0	0	4	4
6	-	Elective - III*	4	0	0	4	4
PRACTICAL							
7	PRA251	R & AC Lab - II	0	0	3	1	3
8	PRA252	Design Project	0	0	6	2	6
		Total				**27**	**33**

Semester - III

Sl. No	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1	-	Elective - IV*	4	0	0	4	4
2	-	Elective - V*	4	0	0	4	4
3	-	Elective - VI*	4	0	0	4	4
4	PRA351	Practical Industrial Training and viva voce (during Previous -end semester vacation)	0	0	0	0	1
PRACTICAL							
5	PRA352	Project Work Phase -I	0	0	12	6	12
		Total				**19**	**24**

Semester - IV

Sl. No	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1	PRA451	Project Work Phase -II	0	0	24	12	24
		Total				**12**	**24**

Elective Courses

Sl. No	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1	PTE 701	Computational Fluid Dynamics	4	0	0	4	4
2	PRA 701	Cryogenic Engineering	4	0	0	4	4
3	PRA 702	Food Processing Preservation & Transport	4	0	0	4	4
5	PRA 703	Building Architecture and HVACR Systems	4	0	0	4	4
6	PRA 704	Energy Conservation HVACR Systems	4	0	0	4	4
7	PTE 708	Fans, Blowers and Compressors	4	0	0	4	4
8	PRA 705	Erection and Maintenance of Refrigeration & Air-conditioning Equipments	4	0	0	4	4
9	PTE 709	Qualitative and Quantitative Research	4	0	0	4	4
10	PRA 706	Air Handling Systems Design	4	0	0	4	4
11	PTE 103	Advanced Fluid Mechanics	4	0	0	4	4

* Student is permitted to choose an elective from other programmes. The electives may include the core subjects offered by other programmes.

Semester wise	Credits
Semester I	25
Semester II	27
Semester III	19
Semester IV	12
Total Credits	83

SEMESTER - I
PMA 101 - ADVANCED ENGINEERING MATHEMATICS

L	T	P	C
4	0	0	4

Goal

Develop the Mathematical skills to formulate certain practical problems, solve them and analytically and numerically and to interpret the results.

Objectives

The course should enable the student to

1. Functional and the concepts of calculus of variation and its properties. Learns techniques to find the extremals of the variational problems involving one many unknown functions, functional dependent on higher order derivatives and isoperimetric problems.
2. Classify the initial and boundary value problems. Understands the D'Alemberts solution of the one dimensional wave equation. Understand the Fourier transform techniques for solving heat flow problems in infinite and semi infinite rod.
3. Learn Harmonic functions and their properties. Understands solving the Laplace equation using Fourier transforms in a half plane with infinite strip and in a semi infinite strip.
4. Classify the partial differential equations. Learn the methods of solving second order partial differential equations numerically.
5. Mapping and learns the concept of conformal mapping by doing the transformation from z plane to w plane

Outcome

The students should be able to:

1. Find the extremals of the functional of different types and uses their technique to find the geodesic and solves isoperimetric problems. Using direct method finds the approximate solution and compares with the exact solutions using Ritz and Kantorovich methods.
2. Form the wave equations with initial conditions and solve them using D'Alemberts solutions. Solves the wave equations using Laplace transform for displacements in long string - long string under its weight and free and forced vibrations. Applies Fourier transform techniques for solving the heat flow problems with infinite and semi infinite rods.
3. Find the steady state temperature by solving the Laplace equation using Fourier transform techniques. Solves the heat flow problems in a half plane with infinite strip and in a semi infinite strip
4. Solve the initial and boundary value problems related heat flow, both one and two dimensional and vibration problems and obtains their numerical solutions. Understands the numerical techniques of solving the partial differential equation in engineering applications.
5. Apply conformal mapping to fluid and heat flow problems.

UNIT - I CALCULUS OF VARIATIONS **12**

Concept of variation and its properties- Euler's Equation-Functional dependant on first and higher order derivatives - Functional dependant on functions of several independent variables-Isoperimetric problems - Direct methods-Ritz and Kantrovich methods

UNIT - II TRANSFORM METHODS **12**

Laplace transform methods for one dimensional wave equation - Displacements in a long string - Longitudinal vibration of an elastic bar - Fourier Transform methods for one dimensional heat conduction problems in infinite and semi-infinite rod

UNIT - III ELLIPTIC EQUATIONS **12**

Laplace equation - Properties of Harmonic functions - Solutions of Laplace equation by means of Fourier transform in a half plane in an infinite strip and in a semi-infinite strip

UNIT - IV NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Solution of Laplace and Poisson equation on a rectangular region by Lieebmann's method - Diffusion equation by the explicit and Crank Nicolson - Implicit methods - Solution of wave equations by explicit scheme Cubic spline interpolation

UNIT - V CONFORMAL MAPPING AND APPLICATIONS **12**

The Schwarz - Christoffel transformation - Transformation of boundaries in parametric form- Physical applications - Application to fluid and heat flow

Total - 60

REFERENCE BOOKS

1. Gupta, A.S. - Calculus of Variations with Applications, Prentice Hall of India(P) Ltd., NewDelhi, 6th print, 2006
2. Sankar Rao, .K. - Introduction to Partial Differential Equations, Prentice Hall of India(P) Ltd., New Delhi, 5th print, 2004
3. Jain.R.K, Iyengar.S.R.K. - Advanced Engineering Mathematics, Narosa publications 2nd Edition, 2007.
4. Grewal, B.S - Numerical Methods in Science and Engineering, Kanna Publications, New Delhi, 6th Edition, 2004.
5. Kandasamy.P , Thilagavathy. K and Gunavathy, K - Numerical Methods, S Chand and Co., Ltd., New Delhi, 5th Edition, 2007
6. Spiegel , M. R - Theory and problems of Complex Variables with an Introduction to Conformal Mapping and Its applications, Schaum's outline series, McGraw Hill Book Co., 1987.

PTE 101 - ADVANCED HEAT TRANSFER

L	T	P	C
4	0	0	4

Goal

The course is intended to build up necessary background for understanding the physical behaviour of various modes of heat transfer like conduction, Turbulent convective Heat Transfer, Phase change Heat Transfer and radiation.

Objectives

The course should enable the students to:

1. Learn the physical behaviour of various modes of heat transfer like conduction, Turbulent convective Heat Transfer, Phase change Heat Transfer and radiation
2. Know the application of various experimental heat transfer correlations in engineering calculations.
3. Understand the thermal analysis and sizing of heat exchangers.
4. Understand the concepts of Radiation Heat Transfer.
5. Learn the concepts of Turbulent boundary layer and its importance in convection phenomenon.
6. Give insight to Numerical Methods In Heat Transfer.

Outcome

The students should be able to:

1. Understand the difference between various modes of Heat Transfer.
2. Know about Finite Difference Method and Finite Volume Method.
3. Understand various correlations involve in Compact Heat Exchanger and Fins.
4. Learn to apply various correlations used in Convective Heat Transfer.
5. Design/sizeing of Heat Exchanger.

UNIT - I CONDUCTION AND RADIATION HEAT TRANSFER **12**

One dimensional energy equations and boundary condition, three-dimensional heat conduction equations, Extended surface heat transfer, Conduction with moving boundaries, Radiation in gases and vapour. Gas radiation and radiation heat transfer in enclosures containing absorbing and emitting media - interaction of radiation with conduction and convection.

UNIT - II TURBULENT FORCED CONVECTIVE HEAT TRANSFER **12**

Momentum and Energy Equations, Turbulent Boundary Layer Heat Transfer, Mixing length concept, Turbulence Model - K-ε Model, Analogy between Heat and Momentum Transfer - Reynolds, Colburn, Vou Karman, Turbulent flow in Tube,a High speed flows.

UNIT - III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER **12**

Condensation with shear edge on bank of tubes, Boiling - pool and flowboiling, Heat exchanger, ε - NTU approach and design procedure, compact heat exchangers.

UNIT - IV NUMERICAL METHODS IN HEAT TRANSFER **12**

Finite difference formulation of steady and transient heat conduction problems - Discretization schemes - Explicit, Crank Nicolson and Fully Implicit schemes, Control volume formulation, Steady one dimensional convection and Diffusion Problems, Calculation of the flowfield- SIMPLER Algorithm.

UNIT - V MASS TRANSFER AND ENGINE HEAT TRANSFER CORRELATION **12**

Mass Transfer, Vaporization of droplets, Combined heat and mass transfer, Heat Transfer Correlations in various applications like I.C. Engines, Compressors & turbines.

TOTAL: 60

REFERENCE BOOKS

1. Incropera F.P. and DeWitt. D.P., 'Fundamentals of Heat & Mass Transfer', John Wiley & Sons, 2009.
2. Ozisik. M.N., 'Heat Transfer - Basic Approach', McGraw-Hill Co., 1985
3. Schlichting, Gersten, 'Boundarylayer Theory', Springer, 8th Edition , 2009.
4. P.K. Nag, 'Heat Transfer', Tata McGraw-Hill,2nd Edition, 2009.
5. Rohsenow. W.M., Harnett. J.P., and Ganic. E.N., 'Handbook of Heat Transfer Applications', McGraw-Hill, NY1985
6. Ghoshdasdidar. P.S., 'Computer simulation of flow and HeatTransfer, Tata McGraw-Hill, 1998
7. Patankar. S.V.' Numerical heat Transfer and Fluid flow' ,Hemisphere Publishing Corporation,2009.
8. Carnahan.B, Luther.H.A., and Wilkes, J.O., Applied Numerical Methods, Wiley and Sons, 1976

PTE 102 - ADVANCED THERMODYNAMICS

L	T	P	C
4	0	0	4

Goal

To provide the students with knowledge on various thermodynamic properties and make them aware of the practical implications of themodynamic relations.

Objectives

The course should enable the students to

1. Gain knowledge availability analysis and thermodynamic properties.
2. Understand real gas behaviours and multi - component systems.

3. Learn chemical thermodynamics and equilibrium.
4. Gain knowledge on statistical thermodynamics.
5. Learn irreversible thermodynamics.

Outcome

The students get the knowledge of:

1. Availability analysis and thermodynamic properties.
2. Real gas behaviours and multi - component systems.
3. Chemical thermodynamics and equilibrium.
4. Statistical thermodynamics and it impact on various applications.
5. Irreversible thermodynamics and it's varied application.

UNIT - I AVAILABILITY ANALYSIS AND THERMODYNAMICS PROPERTY RELATIONS 12

Reversible work, Availability, Irreversibility and Second-Law Efficiencyfor a closed System and Steady-State Control Volume. Availability Analysis of Simple Cycles. Thermodynamics Potentials, Maxwell relations, Generalised relations for changes in Entropy. Internal Energy and Enthalpy, Generalised Relations for Cp and Cv' Clausius Clayperon Equation, Joule-Thomson Coefficient, Bridgman Tables for Thermodynamics relations.

UNIT - II REAL GAS BEHAVIOUR AND MULTI-COMPONENT SYSTEMS 12

Different Equations of State, Fugacity, Compressibility, Principles of Corresponding states, Use of generalised charts for enthalpy and entropy departure, fugacity coefficient,Lee-Kesler generalised three parameter tables. Fundamental property relations for systems of variable composition, partial molar properties, Real gas mixtures, ideal solution of real gases liquids, Activity, Equilibrium in multi phase systems, Gibbs phase rule for non-reactive components.

UNIT - III CHEMICAL THERMODYNAMICS AND EQUILIBRIUM 12

Thermochemistry, First Law analysis of reacting systems, Adiabatic Flame temperature. Entropy change of reacting systems. Second Law analysis of reacting systems, Criterion for reaction equilibrium, Equilibrium constant for gaseous mixtures, evaluation of equilibrium composition, Chemical availability, Availability of reacting systems.

UNIT - IV STATISTICAL THERMODYNAMICS 12

Microstates and Macrostates, Thermodynamic probability, Degeneracy of energy levels,

Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein Statistics, Microscopic Interpretation of heat and work, Evaluation of entropy, Partion function, Calculation of the Macroscope properties from partition functions, Equilibrium constant statistical thermodynamics approach.

UNIT - V IRREVERSIBLE THERMODYNAMICS 12

Conjugate Fluxes and Forces, Entropy Production, Onsager's Reciprocity relations, Thermo-electric phenomena, formulations, Power Generation, Refrigeration.

TOTAL : 60

REFERENCES

1. Kenneth Wark Jr., Advanced Thermodynamics for Engineers , McGraw-Hill Inc., 1995.
2. Bejan, A., Advanced Engineering Thermodynamics, John Wiley and Sons, 3rd Edition, 2006.
3. Holman, J.P. Thermodynamics, 4th edition, McGraw-Hill Inc., 4th Edition , 1988.
4. Smith, J.M. and Van Ness., H.C., Introduction to Chemical Engineering Thermodynamics, McGraw-Hill Inc., 6th Edition , 2007.
5. Sonntag, R.E., and Van Wylen, G, Introduction to Thermodynamics, Classical and statistical, Third Edition, John Wiley and Sons, 1991.
6. Sears, F.W. and Salinger G.I. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Third Edition, Narosa Publishing House, New Delhi, 1998.
7. Dehoff, R.T., Thermodynamics in Materials Science, McGraw-Hill, 1993.
8. Rao, Y.R.C., Postulational and Statistical Thermodynamics, Allied Publisher Limited, New Delhi, 1994.

PTE 104 - INSTRUMENTATION IN THERMAL SYSTEMS

L	T	P	C
4	0	0	4

Goal

To provide the students with knowledge on various instrument and methods of measurement used in thermal engineering.

Objectives

The course should enable the students to

1. Classify the measuring instruments and understand the type of errors as to arrive at the correct measurement.
2. Understand the use of microprocessors in measuring instruments.
3. Learn the methods of measuring the physical quantities
4. Gain knowledge about various flow visualization methods.
5. Learn the various measurement analysis techniques.

Outcome

The students should get the knowledge of:

1. Identifying the various measuring instruments and read error free measurement.
2. Use microprocessors as a part of measuring system.
3. Measuring various physical quantities with apt methods.

4. Various types of flow visualization methods

5. Various measurement analysis techniques for apt applications.

UNIT - I MEASUREMENT CHARACTERISTICS **12**

Instrument Classification,Characteristics of Instruments - Static and dynamic, Experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments.

UNIT - II MICROPROCESSORS AND COMPUTERS IN MEASUREMENT **12**

Data logging and acquisition, Use of intelligent instrument for error reduction, Elements of micro-computer interfacing, Intelligent instruments in use.

UNIT - III MEASUREMENT OF PHYSICAL QUANTITIES **12**

Measurement of thermo-physical properties, Instruments for measuring temperature pressure and flow, Use of intelligent instruments for the physical variables.

UNIT - IV FLOW VISUALISATION **12**

Techniques, Shadow graph, Schileren, interferometer, Laser Doppler anemometer, Heat flux measurement, Telemetry in engines.

UNIT - V MEASUREMENT ANALYSIS **12**

Chemical,. Thermal, Magnetic and Optical gas analysers, Measurement of smoke, dust and moisture, Gas Chromatography, Spectrometry, Measurement pf pH, Review of basic measurement techniques.

TOTAL : 60

REFERENCES

1. Holman, J.P., Experimental methods for engineers, McGraw-Hill, 7th Edition , 2008..

2. Barney, Intelligent Instrumentation, Prentice Hall of India, 1988.

3. Prebrashensky. V., Measurement and Instrumentation in Heat Engineering, Vol.1 and 2 MIR Publishers, 2nd Edition, 1988.

4. Raman, C.S. Sharma, G.R., Mani, V.S.V., Instrumentation Devices and Systems, Tata McGraw-Hill, New Delhi, 2009.

5. Doeblin, Measurement System Application and Design, McGraw-Hill, 1978.

6. Morris. A.S, Principles of Measurements and Instrumentation Prentice Hall of India, 1998.

PRA 101 - REFRIGERATION SYSTEMS DESIGN

L	T	P	C
4	0	0	4

Goal

To expose the principles and design of various systems involved in refrigeration.

Objectives

The course should enable the students to:

1. Know about Refrigeration cycles
2. Understand the Various Components: its working and design
3. Know about system balancing and Controls involved in Refrigeration units
4. Learn about unconventional refrigeration cycles

Outcome

The students should be able to:

1. Understand the various types of refrigeration systems and Psychrometric processes.
2. Learn the classification of refrigerants and its properties
3. Understand about different controls relays and motors employee in refrigeration.
4. Estimate the cooling load.
5. Know about the Air-Conditioning equipments and their applications.

UNIT - I REFRIGERATION CYCLES - ANALYSIS **12**

Carnot Cycle, Air Refrigeration Cycles, Vapor Compression Refrigeration Cycle from Basic - Analysis Multipressure Systems, Cascade Systems.

UNIT - II MAIN SYSTEM COMPONENTS **12**

Compressors, Condensers, Evaporators - Types and performance, Expansion devices - types and selection.

UNIT - III REFRIGERANTS - HANDLING **12**

Classificationof Refrigerants, Refrigerant properties, Oil Compatibility, Environmental Impact - Montreal / Kyoto protocols - Eco Friendly Refrigerants.

UNIT - IV SYSTEM BALANCING & CONTROLS **12**

Estimation of Cooling Load, System Equilibrium, Balancing and matching of components, and Cycling Controls, Electric Circuits in - Refrigerators, Window A/C, Types of motors, Relays, Different Types of Refrigeration Tools, Evacuation and Charging Unit, Recovery and Recycling Unit, Vacuum Pumps.

UNIT - V UNCONVENTIONAL REFRIGERATION CYCLES **12**

Vapor Absorption Systems - Aqua Ammonia & LiBr Systems, Steam Jet Refrigeration Thermo Electric Refrigeration.

TOTAL : 60

REFERENCES

1. Dossat R.J., Principles of refrigeration, John Wiley, S.I. Version ,4th Edition , 2006..
2. W.F. Stoecker, Refrigeration and Air conditioning, McGraw-Hill Book Company, 1989.
3. Jordan and Priester, Refrigeration and Air conditioning, 1985.
4. Goshnay W.B., Principles and Refrigeration, Cambridge, University Press, 1982.
5. Langley, Billy C., 'Solid state electronic controls for HVACR' Prentice-Hall 1989.

WEB REFERENCES

1. http://gort.ucsd.edu/newjour/i/msg02859.html
2. http://www.brazeway.com/refrigeration
3. http://Progdev.sait.ab.ca/pwen220/119.ref-com.htm
4. http://147.46.94.112/journal/sej

PTE 707- THERMAL ENERGY SYSTEMS

L	T	P	C
4	0	0	4

Goal

The goal of the course is to learn different aspects of designing and simulating thermal and energy systems. The course is designed in order to demonstrate how knowledge from junior level classes such as thermodynamics, heat transfer, fluid mechanics, engineering economics, and numerical analysis can be used to design and simulate energy systems.

Objectives

The course should enable the students to:

1. Utilize the students' knowledge of thermodynamics, heat transfer and fluid mechanics in the design of integrated thermal systems.
2. Utilize accurate and efficient computational methods for the solution of thermal system models.

Outcome

The students should be able to:

1. design and apply knowledge of mathematics, science and engineering
2. design a system, component or process to meet desired needs
3. understand the professional and ethical responsibility
4. use statistics and linear algebra
5. work professionally in both thermal and mechanical systems areas including the design and realization of such systems
6. work effectively as team members in mechanical engineering projects

UNIT - I DESIGN OF THERMAL SYSTEM **12**

Design Principles, Workable systems, Optimal systems, Matching of system components, Economic analysis, Depreciation, Gradient present worth factor.

UNIT - II MATHEMATICAL MODELLING **12**

Equation fitting,Nomography, Emperical equation, Regression analysis, Different modes of mathematical models, selection, computer programmes for models.

UNIT - III MODELLING THERMAL EQUIPMENTS **12**

Modelling heat exchangers, evaporators, condensers, absorption and rectificationcolumns, compressor, pumps, simulation studies, information flow diagram, solution procedures.

UNIT - IV SYSTEMS OPTIMIZATION **12**

Objective function formulation, Constraint equations, Mathematical formulation, Calculus method, Dynamic programming, Geometric programming, Linear programming methods, solution procedures.

UNIT - V DYNAMIC BEHAVIOUR OF THERMAL SYSTEM **12**

Steady state simulation, Laplace transformation, Feedback control loops, Stability analysis, Non-linearties.

TOTAL : 60

REFERENCES

1 . J.N. Kapur, Mathematical Modelling, Wiley Eastern Ltd., New York, 2008.

2. F. Stoecker, Design of Thermal Systems, McGraw-Hill, 1989.

3. W.F. Stoecker, Refrigeration and Air conditioning, TMH, 1985.

4. Fanger P.O., Thermal Comfort, McGraw-Hill, USA, 1972.

5. McQuiston FC & Parker TD, Heating, Ventilating and Air conditioning, Analysis and Design, John Wiley & Sons, USA, 5th Edition 2001.

WEB REFERENCES

1. http://www.engr.usak.ca/dept/mee/research/thermal_fluid.html

2. http://at.youku.ca/cgi-bin/amca/cadl-26

3. http://www.gre.ac.uk/research/cms/centre

4. http://naca.larc.nasa.gov

PRA 151 - REFRIGERATION AND AIR CONDITIONING LAB - I

L	T	P	C
0	0	3	1

Goal

To gain experimental knowledge on the performance and operation of Refrigeration and Air Conditioning Equipments.

Objectives

The objective of this Lab is to provide opportunity for the students to expose to the various application and analysis of R & AC equipments.

Outcome

The students can understand the practical working of Refrigeration and Air Conditioning Equipments

List of Experiments

1. Study of refrigeration and air conditioning system components
2. Study of refrigeration and air conditioning tools
3. Charging and leak testing of refrigerating and air conditioning equipments
4. Assembling and dismantling of a refrigerator
5. Assembling and dismantling of a window air conditioner
6. Performance study in a refrigerator with calorimeter
7. Performance comparison of a window air conditioner with air cooled and water cooled condenser conditional distributions.

SEMESTER - II
PRA 201- AIRCONDITIONING SYSTEMS DESIGN

L	T	P	C
4	0	0	4

Goal

To expose the fundamental concepts and design principles of air conditioning and air distribution systems.

Objectives

The course should enable the students to:

1. Know about Refrigeration cycles.
2. Understand the Various Components: its working and design.
3. Know about Psychrometry and Air conditioning
4. Make Cooling load estimations.

Outcome

The students should be able to:

1. Understand the Refrigeration Cycles and know about the various components used in Air-conditioning.
2. Understand the Psychrometric processes and use Psychrometric charts in design.
3. Appreciate the requirements of comfort Air-Conditioning and do cooling load calculation.
4. Know about the Air-Conditioning and air distribution equipments and their applications.

UNIT - I PSYCHROMETRY **12**

Moist Air Properties,use of Psychrometric Chart,Various Psychrometric Processes,Air Washer, Adiabatic Saturation.

UNIT - II APPLIED PSYCHROMETRY & SYSTEM DESIGN **12**

Air conditioning Processes - RSHF, Summer Air conditioning, Winter Air conditioning, Bypass Factor, Applications with specifiedventilation air quantity - use of ERSHF, Application with low latent heat loads and high latent heat loads.

UNIT - III LOAD ESTIMATION & AIR CONDITIONING CONTROL **12**

Solar Radiation - Heat Gain through Glasses, Heat Transfer through Walls and Roofs - Total Cooling Load Estimation, Controls of Temperature, Humidity and Airflow.

UNIT - IV AIR DISTRIBUTION & FANS **12**

Flow through Ducts, Static & Dynamic Losses, Air Outlets, Duct Design - Equal Friction Methods, Indoor Air Quality, Thermal Insulation, Fans & Duct System Characteristics, Fan Arrangement.

UNIT - V CHILLED WATER CIRCUITS **12**

Water Piping in Chilled Water Systems, Condensers, Multiple Condensers and Cooling Towers.

TOTAL : 60

REFERENCES

1. Carrier Air conditioning Co., Handbook of Air conditioning systems design, McGraw-Hill, 1985.
2. Langley, Billy C., Refrigeration and Air conditioning Ed. 3, Engle wood Cliffs (NJ), Prentice Hall, 1986.
3. ASHRAE, Fundamentals and equipment, 4 volumes-ASHRAE Inc. 1985.
4. Jones, Air conditioning engineering, Edward Arnold pub. 1987.
5. C.P. Arora, Refrigeration and Air conditioning, Tata McGraw-Hill Pub. Company, New Delhi, 2nd Edition , 2007.

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1. http://www.199.212.18.76/ozone/refrig_cop/fluoro_e.pdf
2. http://www.confex.com/store/ashrae/index-features.html
3. http://202.79.82/huacglobal/homepage/AIRDISTRIBUTION.htm

PRA 202 - COMPUTER SIMULATION OF REFRIGERATION & AIR-CONDITIONING SYSTEMS

L	T	P	C
4	0	0	4

Goal

The goal of the programme is to provide a theoretical input towards the working knowledge on the operations of modelling, programming and executing simulation techniques for design and optimization.

Objectives

The course should enable the students to:

1. Learn the different types of R &AC system and different thermodynamic processes involved
2. Know the different programming languages and software packages that will be used in the course.
3. Learn the mathematical modelling of different thermodynamic processes in refrigeration cycle and to solve problems and able to model properties of fluids.

Outcome

The students should be able to:

1. Understand the different types and cycles of Refrigeration systems.
2. Understand simulation procedures and implement in analysis.
3. Differentiate and design between a workable and optimal system.

UNIT - I INTRODUCTION **12**

Principles of R&AC Systems,Different thermodynamic cycles,Computer application,Simulation methodology, Programming techniques.

UNIT - II MATHEMATICAL MODELLING FOR SIMULATION **12**

Mathematical models, Principles, Types, Equation fitting,Information Flow Diagram, Workable Systems, Optimal Systems.

UNIT - IIIOPTIMISATION TECHNIQUES **12**

Simulation of Refrigeration Cycles, Flowcharting and programming, Dynamic process simulation, Optimisation techniques, Principles, Lagrange method, Geometric programming method, Linear programming method, Case studies.

UNIT - IV SIMULATION OF REFRIGERATION SYSTEMS **12**

Condenser simulation, Evaporator simulation, Simulation of refrigeration piping, Simulation of control systems.

UNIT - V SIMULATION OF AIR CONDITIONING SYSTEMS **12**

Computerized cooling load calculations, Packages, Simulation of pschrometric processes, Simulation of air flowin AC systems, EER value assessment Environmental issues in simulation, Computerized exergy calculation.

TOTAL : 60

REFERENCES

1. Kapur J.N., Mathematical Modelling, Wiley Easter Limited, New Delhi, 1989.
2. Stoecker, W.F., Refrigeration and air conditioning, TMH 1985.
3. ASHRAE Guide, application, ASHRAE inc. USA, 1985.
4. Dossat, R. J., Principles of refrigeration, John Wiley, 4th Edition , 2006..
5. Lanqley, Billy C., Refrigeration and Air-conditioning Edn.3, engle wood chiffs (NJ), Prentice Hall, 1986.
6. Stoecker, W.F., Design of Thermal Systems, 3rd Edition, McGraw-Hill Book Company, New York, 1989.
7. Anand A. Samuel, Computer Simulation of R&AC Systems - Web course hand book AnnaUniversity, 2000.

WEB REFERENCES

1. www.dl.ac.uk/ccp/ccp5/main.html
2. www.nist.gov/srd/webguide/nist73/73_1.html
3. www.ntu.edu.sg/home/mflton/ftp.html
4. www.tecnet.co.za/mags/mol/archieve1.html
5. www.seds.org/pub/faq/ACRONYMS.

PRA 203 - REFRIGERATION MACHINERY & COMPONENTS

L	T	P	C
4	0	0	4

Goal

To expose the principles, design aspects and design codes of various components involved in refrigeration design..

Objectives

The course should enable the students to:

1. Understand the Various Components: compressors, condensers, evaporators and expansion devices its working and design
2. Know about various refrigeration accessories and its control
3. Exposed to various codes used in design of refrigeration systems

Outcome

The students should be able to:

1. Know to analyse the manufacturers catalogue.
2. Select the capacity of various components based on design requirements.
3. Understand use age of various accessories and controls involved in RAC systems
4. Use BIS codes to analyze and compare the performance of different refrigeration systems.

UNIT - I REFRIGERANT COMPRESSORS **12**

Hermetic compressors - Reciprocating, Rotary, Scroll Compressors, Open type compressors - Reciprocating, Centrifugal, Screw Compressors. Semi hermetic compressors - Construction, working and Energy Efficiency aspects. Applications of each type.

UNIT - II DESIGN OF CONDENSERS **12**

Estimation of heat transfer coefficient, Fouling factor, Friction factor. Design procedures, Wilson plots, Designing different types of condensers, BIS Standards, Optimisation studies.

UNIT - III DESIGN OF EVAPORATORS **12**

Different types of evaporators, Design procedure, Selection procedure, Thermal Stress calculations, Matching of components, Design of evaporative condensers.

UNIT - IV REFRIGERATION SYSTEM COMPONENTS **12**

Evaporators and condensers - Different types, capacity control, circuitry, Oil return, Oil separators - Different types Refrigerant driers strainers, Receivers, Accumulators, Low pressure receivers, Air Washers, Spray ponds.

UNIT - V SYSTEM ACCESSORIES AND CONTROLS **12**

Refrigerant Pumps, Cooling Tower fans, Compressor Motor protection devices, Oil equalising in

multiple evaporators, Different Defrosting and capacity control methods and their implications - Testing of Air conditioners, Refrigerators, Visicoolers, Cold rooms, Calorimetric tests.

TOTAL : 60

REFERENCES

1. Chlumsky, "Reciprocating & Rotary compressors", SNTL Publishers for Technical literaure, 1965.
2. Hains, J.B, " Automatic Control of Heating & Airconditioning" Mc Graw Hill, 1981.
3. Althose, A.D. & Turnquist, C.H. " Modern Refrigeration and Airconditioning" Good Heart - Wilcox Co. Inc., 1985.
4. Recent release of BIS Code for relevant testing practice.
5. ASHRAE Hand book : Equipments, 1998
6. Cooper &Williams, B."Commercial, Industrial, Institutional Refrigeration, Design, Installation and Trouble Shooting " Eagle Wood Cliffs (NT) Prentice Hall, 1989.

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1. http://www.chensources.com/ctowers22.shtml
2. http://www.fortunecity.com/campus/german/201/ctowers.html
3. http://www.aquasystemsinsc.com/metric-files.html
4. http://www.ori.org.

PRA 251 - REFRIGERATION AND AIR CONDITIONING LAB II

L	T	P	C
0	0	3	1

Goal

To gain experimental knowledge on the performance and operation of Refrigeration and Air Conditioning Equipments.

Objectives

The objective of this Lab is to provide opportunity for the students to expose to the various application and analysis of R & AC equipments.

Outcome

The students can understand the practical working of Refrigeration and Air Conditioning Equipments.

LIST OF EXPERIMENTS

1. Performance study in a heat pump for different indoor and outdoor conditions
2. Performance study in a deep freezer for different coil temperature
3. Performance study in a water cooler for various load conditions

4. Performance study in a walk in cooler
5. Capillary optimization study in a refrigerator using non-cfc refrigerants
6. Performance study in a cooling tower
7. Performance analysis of automobile air conditioning system
8. Performance analysis of a centralized air conditioning system .

PRA 252 - DESIGN PROJECT

L	T	P	C
0	0	6	2

Goal

To design and fabricate components related to refrigeration and air conditioning and demonstrate its working.

Objectives

The course should enable the students to:

1. Provide opportunity for the students to implement their skills acquired in the previous semesters to practical problems.
2. Expose the students to Technical report writing.

Outcome

The students should be able to:

1. Complete understanding of making a product is achieved
2. Knowledge on preparing a technical report is gained.

Cycle I:

a. Steady and Unsteady state conduction in Solids
b. Steady state natural convection
c. Steady state Radiation between Black bodies
d. Combined conduction & convection (Fluid - Solid)
e. Unsteady state Conduction & Convection Fluid - Solid
f. Steady and unsteady state conduction and convection in Fluids
g. Steady state Forced convection between Grey bodies.
h. Combined conduction & convection in Fluids

Cycle II

The students should do the simulation project individually and in exceptional cases 2 members may be permitted to take one small item for design and simulation. Every project work shall have a guide who is the member of the faculty of the institution.

The students are required to design and simulate the chosen item in the college and demonstrate its working apart from submitting the project report. The report should contain the required drawings, information flow diagrams, process charts related to simulation.

PRI 351-PRACTICAL TRAINING

SEMESTER - III

PRA 352 - PROJECT WORK PHASE - I

L	T	P	C
0	0	12	6

Goal

To prepare the students to identify a project in the thrust areas and to create a work plan to design, fabricate and to analyze the refrigeration and air conditioning systems.

Objectives

The course should enable the students to:

1. Provide opportunity for the students to implement their skills acquired in the previous semesters to practical problems.
2. To expose the students to do Literature survey and scheduling workplan.
3. Expose the students to Technical report writing.

Outcome

The students should be able to:

1. Students can identify the thrust areas in their field of interest.
2. Compare and analyze the performance of the various systems through literature survey.
3. Complete understanding of making a product is achieved
4. Knowledge on preparing a technical report is gained.

Aim is to train the students in research work, writing report and presentation Phase - I : Shall consist of identificationof the project after literature survey. Students should present a review paper & submit it to the internal examiners. Report should summarise the methodology to be adopted and work plan for the project work Phase - II.

SEMESTER - IV
PRA 451 - PROJECT WORK PHASE - II

L	T	P	C
0	0	24	12

Goal

To prepare the students to identify a project in the thrust areas. To design, fabricate and to analyze the refrigeration and air conditioning systems.

Objectives

The course should enable the students to:

1. Provide opportunity for the students to implement their skills acquired in the previous semesters to practical problems.
2. To expose the students to work as scheduled in work plan.
3. Expose the students to Technical report writing.

Outcome

The students should be able to:

1. Students can identify the thrust areas in their field of interest.
2. Compare and analyze the performance of the various systems both theoretically and practically through actual design and fabrication.
3. Complete understanding of making a product is achieved.
4. Students can prepare technical reports.

Requirement:

Actual project work with presentation & submission of project report thesis form to the examiners. The students should publish at least one paper in National / International conference or Journal before submission of the thesis. Proof of acceptance must be enclosed in the thesis.

PTE 701 - COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
4	0	0	4

Goal

To teach the students about the type fluid mechanics which uses numerical methods and algorithm to solve complex problems in fluid flow.

Objectives

The course should enable the students to:

1. Learn about different governing equation and boundary condition
2. Enable the students to understand the various discretisation techniques and solving solution methodologies.

3. Understanding the Navier-stroke equation for different flow field.

4. Understand the requirement of the different turbulence model for solving the Reynolds Average Navier-stroke equation

5. Learn the different grid generation methods.

Outcome

The students should be able to:

1. Know the formation different governing equation like continuity, momentum and Energy equation

2. Derive discretisation equation using finite difference method and finite volume methods, Numerical error associated with first order and second order.

3. Derive Reynolds average Nevier-stroke equation

4. Fix the closure problem associated with Reynolds average Nevier stroke equation using different turbulence model.

5. Generate the grid required in the computational domain for solving the Navier-stroke equation.

UNIT - I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 12

Basics of CFD, Governing equations of Fluid Dynamics - Continuity momentum and Energy equations, Physical Boundary conditions, Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations

UNIT - II DISCRETISATION TECHNIQUES AND SOLUTION METHODOLOGIES 12

Methods of deriving discretisation equations - Finite difference & Finite volume methods, Finite difference discretisation of wave equation, Laplace equation, Burger's equation, numerical error and stability analysis. Time dependent methods - Explicit, Implicit - Crank - Nicolson methods, time split methods. Solution methodologies - Direct & iteractive methods - Thomas algorithm - Relaxation method - Alternate Direction Implicit method.

UNIT - III CALCULATION OF FLOW - FIELD FOR N - S EQUATIONS 12

Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional convection and diffusion. Representation of the pressure - gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and velocity corrections - Pressure Correction equation, SIMPLE algorithm and its variants.

UNIT - IV TURBULENCE MODELLING 12

Time averaged equation for turbulent flow,Turbulence Models - Zero equation model, oue equation model, two equation k-? models, Advanced models.

UNIT - V GRID GENERATION 12

Algebraic Methods - Differential Equation methods - Adaptive grids

TOTAL: 60

REFERENCES

1. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2nd Edition 2008..
2. Ghoshdasdidar, P.S., "Computer Simulation of flowand heat transfer" Tata McGraw-Hill Publishing Company Ltd., 1998.
3. Subas, V.Patankar "Numerical heat transfer fluidflow",Hemisphere Publishing Corporation, 2009.
4. Taylor, C and Hughes, J.B."Finite Element Programming of the Navier Stokes Equation", Pineridge Press Limited, U.K., 1981.
5. Fletcher, C.A.J. "Computational Techniques for Fluid Dynamics 1" Fundamental and General Techniques, Springer - Verlag, 1987.
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7. Bose, T., "Numerical Fluid Dynamics" Narosa Publishing House, 1997.
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9. D. A, Anderson, John C. Tannehill, Richard H. Pletcher - Computational Fluid Mechanics and Head Transfer, Hemisphere publishing corporation, McGraw - Hill book company, USA, 1984.

PRA 701 - CRYOGENIC ENGINEERING

L	T	P	C
4	0	0	4

Goal

The goal of the course is to learn about cryogenic properties and cryogenic temperatures and applications of the same in various fields.

Objectives

The course should enable the students to:

1. Learn about the concept of cryogenics and applications in various fields.
2. Learn about various cycles of cryogenics.
3. Learn about the cryogenic refrigerators for different applications.
4. Learn about the handling and instrumentation of cryogenic fluids.

Outcome

The students should be able to:

1. Select the proper cryogenic fluid for particular application like cryometallurgy, medical applications.

2. Select proper liquefaction cycle.

3. Decide proper cryogenic refrigerator and cooler for particular application.

4. Find the way to handle cryogenic fluid and right instrumentation to measure the properties of cryogenic fluid.

UNIT - I INTRODUCTION **12**

Insight on Cryogenics, Properties of Cryogenic fluids,Material properties at Cryogenic Temperatures. Applications of Cryogenics in Space Programs, Superconductivity, Cryo Metallurgy, Medical applications.

UNIT - II LIQUEFACTION CYCLES **12**

Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles. Inversion Curve - Joule Thomson Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claudes Cycle Dual Cycle, Ortho-Para hydrogen conversion, Eollins cycle, Simpson cycle, Critical Components in Liquefaction Systems.

UNIT - III SEPARATION OF CRYOGENIC GASES **12**

Binary Mixtures, T-C and H-C Diagrams, Principle of Rectification,RectificationColumn Analysis - McCabe Thiele Method. Adsorption Systems for purification.

UNIT - IV CRYOGENIC REFRIGERATORS **12**

J.T.Cryocoolers, Stirling Cycle Refrigerators, G.M.Cryocoolers, Pulse Tube Refrigerators Regenerators used in Cryogenic Refrigerators, Dilution refrigerators, Magnetic Refrigerators.

UNIT - V HANDLING OF CRYOGENS **12**

Cryogenic Dewar, Cryogenic Transfer Lines. Insulations used in Cryogenic Systems, Instrumentation to measure Flow, Level and Temperature.

TOTAL : 60

REFERENCES

1. Klaus D. Timmerhaus and Thomas M. Flynn, Cryogenic Process Engineering, Plenum Press, New York, 1989.

2. Randall F. Barron, Cryogenic Systems, McGraw-Hill, 1985.

3. Scott R.B., Cryogenic Engineering, Van Nostrand and Co., 1962.

4. Herald Weinstock, Cryogenic Technology, 1969.

5. Robert W. Vance, Cryogenic Technology, Johnwiley & Sons, Inc., New York, London.

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1. www.nasa.gov

2. www.cryogenicsociety.org/

3. www.iifiir.org/

4. www.linde.com

5. www.airliquide.com/
6. www.cern.ch
7. www.nist.gov.

PRA 702 - FOOD PROCESSING, PRESERVATION AND TRANSPORT

L	T	P	C
4	0	0	4

Goal

To provide an equivalent depth of knowledge in several food processing techniques, their protection and the transference techniques.

Objectives

The course should enable the students to

1. Recognize the basic microbiology of food products.
2. Understand the various food processing techniques.
3. To know about the process of freezing and drying in food processing techniques.
4. To know the basic facts of Energy conservation techniques.
5. To understand the design features of refrigerated transportation.

Outcome

The students should be able to

1. Analyze the mechanism of food spoilage and acquire additional parameters of food products.
2. Predict the method of food processing technique for energy conservation.
3. Analyse the food preserving techniques related with drying limitations.
4. Evaluate the various energy conservation technique adopted for freezers and cold storages.
5. Explore the feasibilities of design features of refrigerated transport.

UNIT - I INTRODUCTION **12**

Microbiology of Food Products, Mechanism of Food Spoilage, Refrigeration Technologies of Food Products, Thermodynamic Properties, Cooling Process and Heat Transfer Parameters of Food Products - Their Effect on Quality, Moisture Losses from Respiration of Food Products, Optimum Cold Storage Conditions.

UNIT - II PROCESSING AND PRESERVATION **12**

Food Processing Techniques, Standard Norms for Processing, Plant Layout, Preservation of Milk, Butter, Fruits, Vegetables, Meat Products, Environment Friendly Food Processing Techniques, Cryofreezing, Energy Conservation in Food Industries.

UNIT - III FREEZING AND DRYING **12**

Precooling, Quick Freezing, Freeze Drying Principles, Techniques and Equipments, Cold Storage and Freezers. Freezing and Drying Limitations. Irradiation Techniques. Food Preserving Techniques for Remote Areas.

UNIT - IV COLD STORAGE DESIGN AND INSTRUMENTATION **12**

Design, Selection, Matching, Installation and Maintenance of Cold Storages & Freezers. Insulation, Instrumentation and Control. Energy Conservation Techniques for Freezers and Cold Storages.

UNIT - V TRANSPORT **12**

Refrigerated Transportation, Refrigerated Containers and Trucks. Design Features, Piping and Role of Cryogenics in Freezing and Transport.

TOTAL : 60

REFERENCES

1. Alan Rodes, Principles of Industrial Microbiology, Pergamon International Pub., 1989.
2. Ibraham Dincer, Heat Transfer in Food Cooling Applications, Tailor & Francis Pub., 1997.
3. Stanley E. Charm, Fundamentals of Food Engineering, III Ed. AVI Pub. Company Inc. 1989.
4. Clive V.I. Dellino, Cold and Chilled Storage Technology, Van Nostrand Reinhold Pub. New York, 1991.
5. Arora C.P., Refrigeration and Air conditioning II Ed. McGraw-Hill, Pub.,2nd Edition , 2007.
6. ASHRAE Handbook, Cold Storage Application - Collection of papers from ASHRAE Winter meeting at Delirious and Chicago, Jan 1988 and 1989.

WEB REFERENCES

1. http://microbial.org/vlmicro/vl_food.html
2. http://www.howstuffworks.com/food-preservation.html
3. http://www.fao.org.wfs/final/e/volumed/t//a-e.html
4. http://www.iifiir.org .

PRA 703- BUILDING ARCHITECTURE AND HVACR SYSTEMS

L	T	P	C
4	0	0	4

Goal

The goal of the course is to design a medium to large industrial and office buildings where safe and healthy building conditions are regulated with respect to temperature and humidity, using fresh air from outdoors.

Objectives

The course should enable the students to:

1. Learn about the factors that determine the climate change along with the effects of geographical location.
2. Learn about the human comfort conditions and effects of climate on metabolic activities of human.
3. To learn about the various building materials for different conditions of climate.
4. To learn about passive and active architecture.

Outcome

The students should be able to:

1. Decide an architecture which takes into effect of climate changes.
2. Design a condition or device for comfort living.
3. Select a proper material taking into account of heat flow conditions in addition to building aesthetics.
4. Decide about the various alternatives for building architecture.

UNIT - I CLIMATE & ARCHITECTURE **12**

Factors that determine climate, Climatic variations - Natural and Man made systems, Climate and vernacular architecture, Natural cooling, Effects of Geographical location.

UNIT - II WEATHER AND COMFORT **12**

Climate and its components, Characteristics of Human Metabolic activities with changing climate, the sensation of heat and comfort zone, Design of solar shading devices and Mechanical Ventilation systems.

UNIT - III BUILDING MATERIALS - THERMAL STUDIES **12**

Building Aesthetics and Thermal infiltration,Periodic heat flowthrough building elements for weather conditions all round the air, Tropical conditions.

UNIT - IV ENVIRONMENT AIR QUALITY CONTROL **12**

Air movement and orientation of buildings, landscaping in the tropics, Design consideration in different climate conditions, Tropical sky scrapers, Effects of Greenery - Natural ventilation.

UNIT - V INTELLIGENT BUILDINGS & HVAC SYSTEMS **12**

Energy resources and conservation related to building environment, Building automation and Energy Management - passive and Active systems, Solar energy to substitute room heating systems.

TOTAL: 60

REFERENCES

1. ASHRAE Hand book - HVAC Systems & Equipment 1992, HVAC Applications 1992, ASHRAE Inc. Atlanta.

2. Kenya, A., Design Primer for Hot climates, Architectural Press, London, 1980.

3. A.J. Davis and P.P. Schubert, Alternative Natural Energy Sources in Building Design, II Edition, Nostrant of Reinhold Co. New York, 1981.

4. National Building code of India 'SP7-1983, Bureau of Indian Standards 1984.

5. Giveni B. Man, Climate & Architecture, Barking Esser Applied Science, 1982.

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1. http://www.egt.bme.hu/ecobuild/vernar.htm
2. http://hern.dis.anl.gov/eehern/96/9603vent.html
3. http://www-air-care.com.sg/hvac.html
4. http://www.pfg.co.za/solutions_building.asp
5. http://www.sardi.sa.gov.au/hort/coolchai/inforkits/ref_sys.

PRA 704 - ENERGY CONSERVATION IN HVACR SYSTEMS

L	T	P	C
4	0	0	4

Goal

The course is intended to impart knowledge on Efficiency, Exergy and irreversibility applicable to refrigeration and air conditioning cycles. Also to enhance the understanding of energy conversion and energy conservation in HVACR systems.

Objectives

The course should enable the students to:

1. Learn about First and Second law of thermodynamics applicable to Refrigeration and Air conditioning Cycles
2. Study about Energy auditing and Energy conservation techniques
3. Understand about heat transformers and heat pumps.

Outcome

The students should be able to:

1. Understand the concept of Energy and Energy
2. Learn about the Conservation modalities in HVACR Systems
3. Analyse different heat transformers and Heat Pumps.

UNIT - I FIRST & SECOND LAW ANALYSIS **12**

Thermodynamics of Energy conservation - Second law - Exergy - Irreversibility and efficiency - analysis of Refrigeration and Air conditioning cycles, Heat pumps, Thermal insulation.

UNIT - II ENERGY CONSERVATION MODALITIES **12**

Energy auditing in Engineering and process Industry, Identifying avenues for Energy conservation, Conservation through periodic maintenance of HVAC systems, Predictive and Preventive maintenance.

UNIT - III REFRIGERATION & AIR CONDITIONING EQUIPMENTS **12**

Energy conservation in Air Handling units - Fans, Air conditioning apparatus - Unitary equipments, Refrigeration Equipments - Reciprocating Refrigeration Machine, Centrifugal Refrigeration Machine, Absorption Refrigeration Machine, Heat Rejection Equipments, Energy Efficient motors.

UNIT - IV HEATING AND VENTILATING SYSTEMS **12**

Energy conservation feasibility analysis - conventional ventilating systems, constant volume induction system, Multizone unit system, Variable volume induction system, constant temperature systems. Heat Pipe Applications in Air conditioning systems.

UNIT - V HEAT CONVERSION SYSTEMS **12**

Theory of Heat transformers - Two temperature level, Three Temperature level, Heat Pumps - Vapour compression and Absorption units, Heat Transformers.

TOTAL : 60

REFERENCES

1. Carrier Air conditioning Co., Hand Book of Air conditioning System Design, McGraw-Hill, 1985.
2. Plant Engineers and Manager's Guide to Energy Conservation, Fair Mount Press, 1987.
3. Ashrae Hand Book - Equipment, 1989.
4. Georg Alefeld and Reinhard Radermacher, Heat conversion systems, CRC press, 1994.
5. Energy conservation in Heating, Cooling and Ventilating Building, Proceeding Hemisphere publishing corporation, 1988.
6. Edward Hartmann, Maintenance Management, Productivity And Quality Publishing Pvt. Ltd. Madras, 1995.

WEB REFERENCES

1. http://www.tinsleymullen.com
2. http://www.eren.doc.gov
3. http://ecep/usl.edu

PTE 708 - FANS, BLOWERS & COMPRESSORS

L	T	P	C
4	0	0	4

Goal

To expose the students in Axial and Centrifugal Flow Thermal Turbomachinery.

Objectives

The course should enable the students to:

1. Learn the principles and theory behind the Thermal Turbo machinery
2. Learn the theory and details of Centrifugal Fans and Compressors.
3. Learn the theory and details of Axial Fans and Compressors.
4. Understand the details and theory behind testing, control and application of Thermal Turbo machinery.

Outcome

The students should be able to:

1. Understand the velocity triangles and calculate the specific work, various losses involved in the Thermal Turbo machines.
2. Know about principles and theories behind the axial and centrifugal turbomachines.
3. Exposure to various testing procedures involving Fans, Compressors and Blowers and also exposure on Noise control of Turbomachinery.

UNIT - I PRINCIPLES OF TURBO MACHINERY **12**

Introduction to turbo machines - Transfer of energy to fluids- Performance characteristics - fan laws - Dimensionless parameters - Specificspeed - selection of centrifugal, axial, mixed flow, Axial flow machines.

NIT - II ANALYSIS OF CENTRIFUGAL BLOWER **12**

Centrifugal Blowers: Theoretical characteristic curves, Eulers characteristics and Eulers velocity triangles, losses and hydraulic efficiency,flowthrough impeller casing inlet nozzle volute, diffusers, leakage disc friction mechanical losses multivane impellers of impulse type, crossflow fans.

UNIT - III ANALYSIS OF AXIAL FLOW **12**

Axial flow fans: Rotor design airfoil theory, vortex theory, cascade effects, degree of reaction, blade twist stage design, surge and stall, stator and casing, mixed flow impellers.

UNIT - IV TESTING AND CONTROL OF FANS **12**

Fan testing, noise control,materials and components blower regulation,speed control, Throttling control at discharge and inlet.

UNIT - V DESIGN AND APPLICATIONS OF BLOWERS **12**

Special design and applications of blowers, induced and forced draft fans for air conditioning plants, cooling towers, ventilation systems, booster systems.

TOTAL : 60

REFERENCES

1. Stepanoff A.J., Turboblowers, John Wiley & Sons, 1970.
2. Brunoeck, Fans, Pergamon Press, 1973.
3. Austin H. Church, Centrifugal pumps and blowers, John Wiley and Sons, 1980.
4. Dixon, Fluid Mechanics, Thermodynamics of turbomachinery Pergamon Press, 2010.
5. Dixon, Worked examples in Turbomachinery, Pergamon Press, 1984.

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1. http://www.petropager.com
2. http://www.erichson.com
3. http://www.apgate.com

PRA 705 - ERECTION AND MAINTENANCE OF REFRIGERATION AND AIR-CONDITIONING EQUIPMENTS

L	T	P	C
4	0	0	4

Goal

The goal of the programme is to expose the student in various parameters such as corrective and preventive measures that has to be considered for erection & maintenance of refrigeration & air-conditioning equipments.

Objectives

The course should enable the students to:

1. Learn the plant lay out and its parameters.
2. Learn the erection methodology and various maintenance procedures.
3. Learn the various testing, reliability analysis of equipments.

Outcome

The students should be able to:

1. Understand the different types of maintenance procedures.
2. Schedule maintenance followed by various industries.
3. Understand the total preventive maintenance principles.

UNIT - I INTRODUCTION **12**

Refrigeration and air-conditioning plant layout, parameters affecting the location, organisational approach.

UNIT - II ERECTION OF R&AC SYSTEMS **12**

Erection methodology, foundation, padding, network analysis, critical path, interconnections; safety precautions, air handling equipments. Maintenance procedures, vacuumising, changing, trial run, leak detection, prevention, lubrication, different methods and equipments, locations in the systems, corrosion, noise, vibration monitoring and control.

UNIT - III TESTING OF EQUIPMENTS **12**

Testing of compressors, condensers, evaporators, cooling towers, motors, controls, test rings, ISI standards. Testing of control systems, circuitry and trouble shooting, condition monitoring.

UNIT - IV TOTAL PREVENTIVE MAINTENANCE **12**

TPM Principles, Corrective and preventive measures, Reliability analysis, Signature analysis, Different types of maintenance procedures, Practical hints, Failure Mode and Effect Analysis, Problem Solving Techniques.

UNIT - V MAINTENANCE SCHEDULES **12**

Studies on different maintenance schedules followed by various industries

TOTAL: 60

REFERENCES

1. Althouse A.D. and Turnquist C.H., Modern refrigeration and air-conditioning, Good Heart-Wilcoz Co Inc., 1980.
2. Nelson C.W., Commercial and Industrial refrigeration, McGraw-Hill, 1982.
3. Paul F. Goliber, Laboratory Manual, Depuar publishing Inc., 1980.
4. Reed G.H., Refrigeration, A Practical Manual, Applied Science Publishers Ltd., London, 1982.
5. Russel E. Smithy, Electricity for Refrigeration, Heating and Air-conditioning, Duxbury Press, Massachusetts, 1980.
6. ASHRAE Hand book on Refrigeration & Air conditioning, Published by ISHRAE, Bangalore, 1998.

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2. www.psfindustries.com/intro.html-9k
3. www.murrob.com/mrci/default.htm
4. www.asme.org/conf/ijpgcol/ol-cfp.pdf
5. www.tecnoarmit.fx.ro/scop.htm-5k

PTE 709 - QUANTITATIVE AND QUALITATIVE RESEARCH

L	T	P	C
4	0	0	4

Goal

To make students to Understand and interpret research reports when you read them, indentifying their major elements and underlying methodologies.

This module is intended to supplement what you will learn from your coursework and reading. It may also help you get an idea of what research is before you take courses in research methods.

Objectives

The course should enable the students to:

1. Identify different research methods and these are compatible with different situations, and therefore it is important to know which method is best suitable for use with a particular hypothesis or question.
2. Give exposure to answer unanswered questions or exploring which currently not exist in a research.

Outcome

The students should be able to:

1. Identify the major differences between qualitative and quantitative research.
2. Describe the pros and cons of using qualitative data collection techniques.
3. Understand in-depth interviewing and focus groups as questioning techniques.
4. Discuss observation methods and explain how they are used to collect primary data.

UNIT - I RESEARCH METHODOLOGY **12**

Types of research- Literature survey- Patent survey- literature review reporting- ethics and interventions of research- planning for research- research tools- seven management tools-graphical representations - Codes - Standards.

UNIT - II QUANTITATIVE METHODS **12**

Descriptions-statistics-distribution-sampling-hypothesis testing- regression-ANOVA- reliability- validity-uncertainty - sensitivity analysis- use of SPSS.

UNIT - III QUALITATIVE METHODS **12**

Historical analogy-market research- survey-analysis-delphi methodology-determination of index-life cycle analysis - modeling and simulation.

UNIT - IV MEASUREMENT IN RESEARCH **12**

Need for measurement- types of measuring instruments- configurationsand functional descriptions of instruments- performance- characteristics- static and dynamic characteristics-manipulation, transmission and recording of data- data acquisition and processing systems-Computer aided experimentation.

UNIT - V RESEARCH REPORT PREPARATION **12**

Principles of Written communication- content preparation- synopsis writing- result analysis-discussion section-case studies.

TOTAL : 60

REFERENCES

1. Robert B. Burns, Introduction to Research methods, SAGE Publications London- 2000
2. Herman J. Ader, Gidon J. mellenbergh, Research Methodology, SAGE Publications London-1999
3. Jeremy Miles& Mark Sherlin, Applying Regression and Correlation, A Guide for students and researchers SAGE Publications London- 2008
4. Ernest O. Doebelin, Measurement Systems- Application and Design IV Edition McGraw-Hill International Edition NY-5th Edition 2007.

PRA 706- AIR HANDLING SYSTEMS DESIGN

L	T	P	C
4	0	0	4

Goal

To expose the student to air distribution and ventilation systems.

Objectives

The course should enable the students to:

1. Principles of air handling and air distribution
2. Know about various air handling system configurations
3. To expose the students to ventilation and air controls.

Outcome

The students should be able to:

1. Know the categories of air handling systems and to design air ducts
2. Understand principle of air flow, its measurement, evaluation and control.
3. Know the concepts of indoor air quality and the applications of constant volume and variable volume systems.

UNIT - I INTRODUCTION **12**

\Psychrometric, Heat to return air and fan heat economizer cycle, Single zone system, Categories of central air handling system, Air handling system Design Consideration, Duct design static Regain - Equal friction- T method.

UNIT - II CONSTANT AND VARIABLE VOLUME SYSTEM **12**

Terminals reheat system, Double-Duct systems, Double-Duct systems with sub zone heating, Double-Duct systems with Draw-through cooling, Two fan Double-Duct systems, Triple-Duct system, Fan coil Unit system, Induction system.

UNIT - III VARIOUS SYSTEM CONFIGURATIONS **12**

Hydronic heat pump systems, Heat recovery and Economizer cycle, Indirect evaporative cooling, Energy conservation and system retrofit.

UNIT - IV VENTILATION FOR CONTROL OF WORK ENVIRONMENT **12**

Ventilation for control, Principle of airflow, Airflowmeasurement techniques, General exhausts ventilation, Air cleaning devices, and replacement-Air system, Evaluation and control of the thermal Environment, Indoor air Quality and Outside Air Requirements.

UNIT - V AIR CONTROLS **12**

Thermostats, Damper and damper motor, Automatic Valves, Direct digital control, Application of fuzzy logic & neural network-Demand control volume method.

TOTAL : 60

REFERENCES

1. Ysen - Yao Sun, Air handling system design, McGraw-Hill, Inc., NY - 1994
2. William A. Burges, Michael j. Ellen Becker, Robert D. Treitman, Ventilation for control of the work environment, A Wiley - Interscience Publication NY - 1989.
3. John I. Levenhagen, Donald H. Spethmann, HVAC controls and systems, McGraw-Hill international Edition. NY - 1992. Allan T. Kirkpatrick & James S. Elleson, Cold air distribution system design guide, ASHEAC - 1996 USA.
4. SMACNA, HVAC System Duct Design, SMACNA Virginia - 1990.

WEB REFERENCES

1. www.environ.com
2. www.ataiaircon.com
3. www.building.org.

PTE 103 - ADVANCED FLUID MECHANICS

L	T	P	C
4	0	0	4

Goal

The goal of the programme is to provide advance concepts for ideal and non ideal flows, to impart the knowledge of various types of flow like two dimensional flow, turbulent flow and compressible flow through ducts and to provide the details shock waves.

Objectives

The course should enable the students to:

1. To understand advance concepts for ideal and non ideal flows.
2. To understand various types of flow like two dimensional flow, turbulent flow and compressible flow through ducts.
3. To understand the details of shock waves.

Outcome

The students should be able to:

1. To know advance concepts for ideal and non ideal flows.
2. To get the knowledge of various types of flow like two dimensional flow, turbulent flow and compressible flow through ducts.
3. To know the details of shock waves.

UNIT - I INTRODUCTION **12**

Ideal and non-ideal flows, general equations of fluid motion, Navier - stokes equations and their exact solutions. Boundary layer theory, wedge flows, laminar flow over plates and through cylinders.

UNIT - II TWO DIMENSIONAL FLOW **12**

Subsonic flow, physical significance of irrotational motion - Kelvin's theorem - Differential equation in terms of velocity Potential and stream function - Flow with small purtubaration - flow past a wave shaped wall - Gothert's rule - Prandtl Glanert rule - Hodograph method

UNIT - III TURBULENT FLOW **12**

Turbulence, models and flow equations: steady and unsteady turbulent boundary layers.

UNIT - IV COMPRESSIBLE FLOW THROUGH DUCTS **12**

Introduction to compressible viscous flow, governing equations, flow with friction flow with heat transfer flow though nozzle and diffusers

UNIT - V SHOCK WAVE **12**

Normal and oblique shocks - Prandtl - Meyer expansion - Rankine - Hugnoit relation, Application of method of characteristics applied to two dimensional case - simple supersonic wind tunnel Design of supersonic wind tunnel and nozzle.

TOTAL: 60

REFERENCES

1. T Radhakrishnan - Gas Dynamics, Prentice Hall, New Delhi.
2. Mohanty A K- Fluid Mechanics, Prentice Hall of India, 1986
3. Shapiro A F -The Dynamics of Compressible flow Vol 1, The Ronald Press company 1963
4. Shames- Mechanics of Fluids, Megraw-Hill Inc
5. Schlichting H - Boundary layer theory, McGraw Hill-Inc
6. Yahya S.M, "Fundamentals of Compressible flow", New Age International (P) Ltd.New Delhi,1996.