



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE
JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur
Department of Mechanical Engineering

Name of Subject: Refrigeration and Air conditioning- (RAC)

Subject Code: 6ME7-11

Year: 3rd Year, 6th Semester



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Department of Mechanical Engineering

Vision and Mission of Institute:

Vision: To become a renowned center of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities.

Mission:

M1: Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.

M2: Identify, based on informed perception of Indian, regional and global needs, areas of focus and provide platform to gain knowledge and solutions.

M3: Offer opportunities for interaction between academia and industry.

M4: Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

Vision and Mission of Department:

Vision: The Mechanical Engineering Department strives to be recognized globally for outcome based technical knowledge and to produce quality human resource, who can manage the advance technologies and contribute to society.

Mission:

M1: To impart quality technical knowledge to the learners to make them globally competitive mechanical engineers.

M2: To provide the learners ethical guidelines along with excellent academic environment for a long productive career.

M3: To promote industry-institute relationship.



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Department of Mechanical Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO1: To equip graduates with a strong foundation in engineering sciences, with an emphasis on mechanical engineering principles, enabling them to analyze, design, and solve real-world engineering challenges.

PEO2: To prepare graduates with sound scientific and engineering fundamentals to innovate and deliver effective solutions addressing practical challenges in mechanical engineering

PEO3: To inculcate in graduates a professional and ethical attitude, effective communication and teamwork skills, a multidisciplinary approach, entrepreneurial mindset, and the ability to connect engineering solutions with societal and environmental concerns.

PEO4: To provide students with an academic environment that fosters excellence, leadership, adherence to ethical standards, and encourages self-motivated lifelong learning essential for a successful professional career in mechanical

PEO5: To prepare students to excel in industry and higher education by providing quality education grounded in strong technical knowledge and high moral values

Program Specific Outcomes (PSOs)

PSO1: Graduates will be able to design, analyze, and fabricate electric and hybrid vehicles using modern engineering tools and sustainable practices.

PSO2: Graduates will be able to apply design principles and computational techniques, including programming and data structures, to analyze and solve mechanical engineering problems.



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Program Outcomes (POs)

- PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
- PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)



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Department of Mechanical Engineering

SYLLABUS



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - VI Semester: B.Tech. : Mechanical Engineering

6ME5-11: REFRIGERATION AND AIR CONDITIONING

Credit: 3
3L+0T+0P

Max. Marks: 150(IA:30, ETE:120)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Introduction: Refrigeration and second law of Thermodynamics, Refrigeration effect and unit of Refrigeration, Heat pump, reversed Carnot cycle. Vapour Compression Refrigeration System: Analysis of simple vapour compression Refrigeration cycle by p-h and T-S diagram. Effect of operating conditions	5
	Multiple Evaporator and compressor system: Application, air compressor system, Individual compressor, compound compression, cascade system. Application, air compressor systems, individual compressor, compound compression, cascade system.	3
3	Gas Cycle Refrigeration: Limitation of Carnot cycle with gas, reversed Brayton cycle, Brayton cycle with regenerative heat exchanger.	4
	Air cycle for air craft: Necessity of cooling of air craft, Basic cycle, boot strap, regenerative type air craft refrigeration cycle.	4
4	Other refrigeration systems (description only): Vapour absorption refrigeration system, Electrolux refrigerator, Lithium Bromide - Water system, Water vapour refrigeration system, Vortex tube refrigeration system, thermo electric refrigeration system.	4
	Refrigerants: Classification, Nomenclature, selection of Refrigerants, global warming potential of CFC Refrigerants. Refrigeration Equipments: Compressor, condenser, evaporator, expansion devices, types & working.	4
5	Psychrometry: Psychrometric properties, psychrometric relations, psychrometric charts, psychrometric processes, cooling coils, Bypass factor, Apparatus Dew point temperature and air washers.	5
	Human Comfort: Mechanism of body heat losses, factors affecting human comfort, effective temperature, comfort chart.	3
6	Cooling load calculations: Internal heat gain, system heat gain, RSHF, ERSHF, GSHF, cooling load estimation, heating load estimation, psychrometric calculation for cooling.	5
	Selection of air conditioning: Apparatus for cooling and dehumidification, Air conditioning system, year round air conditioning.	3
	TOTAL	41



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Department of Mechanical Engineering

Subject: Refrigeration And Air Conditioning

Code: 6ME5-11

Refrigeration and Air Conditioning

CO1: Understand the principles of refrigeration and air conditioning, including basic cycles and components.

CO2: Analyze performance of vapour compression, vapour absorption, and other refrigeration systems.

CO3: Evaluate psychrometric properties and processes for air conditioning applications.

CO4: Apply methods for designing and selecting refrigeration and air conditioning equipment.

CO5: Assess energy efficiency, COP, and environmental impacts of refrigeration and air conditioning systems.

CO6: Analysis different solutions for energy-efficient and sustainable cooling systems.

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	2	1	1	1	1	1	2	3	2
CO2	3	3	3	3	3	1	1	1	2	1	2	3	3
CO3	3	3	3	3	3	1	1	1	2	1	2	3	3
CO4	3	3	3	3	3	1	1	1	2	1	3	3	3
CO5	3	3	3	3	3	1	2	2	3	1	3	3	3
CO6	3	3	3	3	3	1	2	3	3	2	3	3	3



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Course Plan

Name of the Course: Refrigeration and Air Conditioning

Code of the course: 6ME-5-11

Name of Faculty: Dr M.P.SINGH

Course Outcomes

CO1: Understand the principles of refrigeration and air conditioning, including basic cycles and components.

CO2: Analyze performance of vapour compression, vapour absorption, and other refrigeration systems.

CO3: Evaluate psychrometric properties and processes for air conditioning applications.

CO4: Apply methods for designing and selecting refrigeration and air conditioning equipment.

CO5: Assess energy efficiency, COP, and environmental impacts of refrigeration and air conditioning systems.

CO6: Analyze different solutions for energy-efficient and sustainable cooling systems.

Unit	Topic	Lec	CO	Specific Objectives	Expected Outcomes	Primary Reference (C.P. Arora)
Intro	Introduction: Objective, Scope & Applications of RAC	1	CO1	Explain scope and importance of refrigeration	Understand applications in industry and comfort cooling	Ch.1 p.1–6
1	Refrigeration & Second Law of Thermodynamics	2	CO1	Explain thermodynamic principles	Relate second law with refrigeration systems	Ch.2 p.13–18
	Refrigeration Effect & Unit of Refrigeration	3	CO1	Define refrigeration effect and ton of refrigeration	Calculate refrigeration capacity	Ch.2 p.18–23
	Heat Pump & Reversed Carnot Cycle	4	CO1	Explain theoretical refrigeration cycle	Evaluate ideal cycle performance	Ch.2 p.23–32
2	Vapour Compression Refrigeration System	5	CO2	Explain components and working	Understand practical refrigeration cycle	Model of Refrigeration device
	VCR Cycle on p-h and T-s Diagram	6	CO2	Explain thermodynamic processes	Analyze cycle performance	Ch.3 p.65–74
	Effect of Operating Conditions	7	CO2	Study condenser and evaporator effects	Evaluate COP variation	Ch.3 p.74–85
	Multiple Evaporator System	8	CO2	Explain multiple evaporator applications	Analyze multi-evaporator systems	Examples of previous year question papers
	Compound Compression & Cascade System	9	CO2	Explain cascade refrigeration	Identify low temperature applications	Ch.4 p.105–118
3	Gas Cycle Refrigeration	10	CO2	Explain limitations of Carnot cycle with gas	Understand air refrigeration	Ch.5 p.135–140
	Reversed Brayton Cycle	11	CO2	Explain working principle	Evaluate performance of gas refrigeration	Ch.5 p.140–150
	Brayton Cycle with Regeneration	12	CO2	Explain regenerative heat exchanger	Improve cycle efficiency	Ch.5 p.150–158
	Aircraft Refrigeration	13	CO2	Explain need of cooling in aircraft	Understand aircraft refrigeration cycle	Ch.6 p.173–180
	Bootstrap & Regenerative Aircraft Cycle	14	CO2	Analyze aircraft cooling methods	Compare aircraft refrigeration cycles	Examples from competitive exams
4	Vapour Absorption Refrigeration System	15	CO2	Explain absorption cycle	Compare VARS with VCRS	Ch.7 p.205–220



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	Electrolux Refrigerator	16	CO2	Explain diffusion absorption system	Understand domestic absorption refrigeration	Ch.7 p.220–228
	Lithium Bromide – Water System	17	CO2	Explain LiBr absorption refrigeration	Identify AC applications	Ch.7 p.228–236
	Other Refrigeration Systems	18	CO6	Introduce vortex tube & thermo-electric refrigeration	Understand modern cooling systems	Ch.7 p.236–248
	Refrigerants: Classification & Nomenclature	19	CO5	Explain refrigerant properties	Select suitable refrigerants	Ch.8 p.261–272
	Environmental Effects of Refrigerants	20	CO5	Explain ODP and GWP	Understand eco-friendly refrigerants	Ch.8 p.272–280
	Refrigeration Equipment	21	CO4	Explain compressor, condenser, evaporator	Identify system components	Ch.9 p.297–310
	Expansion Devices	22	CO4	Explain expansion valves	Select suitable expansion device	Ch.9 p.310–325
5	Psychrometric Properties	23	CO3	Explain moist air properties	Interpret psychrometric parameters	Ch.10 p.343–352
	Psychrometric Chart	24	CO3	Explain chart construction	Use chart for analysis	Ch.10 p.352–360
	Psychrometric Processes	25	CO3	Explain heating, cooling & humidification	Perform psychrometric calculations	Examples from competitive exams
	Cooling Coils & Bypass Factor	26	CO3	Explain apparatus dew point	Evaluate cooling coil performance	Ch.10 p.372–380
	Air Washers	27	CO3	Explain air washer working	Apply air conditioning processes	Ch.10 p.380–387
	Human Comfort	28	CO3	Explain body heat loss	Identify comfort conditions	Ch.11 p.401–410
	Comfort Chart	29	CO3	Explain effective temperature	Interpret comfort zones	Ch.11 p.410–418
6	Cooling Load Calculations	30	CO4	Explain internal heat gains	Estimate cooling load	Examples from competitive exams
	RSHF, ERSHF, GSHF	31	CO4	Explain heat factors	Perform load calculations	Ch.12 p.445–455
	Cooling Load Estimation	32	CO4	Analyze building cooling load	Perform design calculations	Ch.12 p.455–468
	Heating Load Estimation	33	CO4	Explain heating requirements	Estimate heating load	Ch.12 p.468–475
	Psychrometric Calculations for Cooling	34	CO3	Apply psychrometric principles	Solve cooling problems	Examples from competitive exams
	Cryogenic engineering	35	CO6	Explain cryogenic engineering	Learnt about the principle and application of system	NPTEL
	Year-Round Air Conditioning	36	CO6	Explain sustainable AC operation	Design energy-efficient systems	Discussion and presentation

Recommended books:

T1: Refrigeration and Air Conditioning, Stoecker W.F., McGraw Hill Publication.

T2: Modern Refrigeration and Air Conditioning, Andrew D. Althouse, Good Heart-Willcox Co.



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