

BMEE320L	Refrigeration and Air-Conditioning	L	T	P	C
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Pre-requisite	BMEE303L, BMEE303P	Syllabus version			
		1.0			
Course objectives					
<ol style="list-style-type: none"> 1. To teach the principles of air and vapour refrigeration systems. 2. To make the students understand the thermodynamics of various refrigeration systems. 3. To enable the students to design summer and winter air conditioning systems. 4. To design various components and controls of refrigeration systems. 					
Course outcome					
<p>At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 1. Analyse the performance of air cycle refrigeration systems. 2. Analyse the performance of vapour compression refrigeration system for various applications. 3. Demonstrate system components and controls of refrigeration and air-conditioning systems. 4. Compare refrigerants and system applications. 5. Analyse the performance of different air-conditioning systems. 6. Apply the knowledge of psychrometry for calculating cooling and heating loads. 					
Module:1	Introduction	8 hours			
Review of fundamentals of fluid mechanics and heat transfer. Basic refrigeration systems – vapour compression refrigeration system (VCRS), vapour absorption refrigeration system (VARs), air cycle refrigeration system, steam jet refrigeration system, thermoelectric system and vortex tube system. Joule thompson coefficient and inversion temperature. Reversed carnot cycle and its limitations, Bell-Coleman, joule or reversed brayton cycle. Aircraft refrigeration cycles.					
Module:2	Vapour compression refrigeration systems	6 hours			
Standard vapour compression refrigeration cycle, actual VCRS, superheat horn and throttling losses, superheating and subcooling in VCRS. Multi-stage VCRS – multi-pressure systems, multi-evaporator systems, cascade systems. LiBr – H ₂ O based VARs and NH ₃ – H ₂ O based VARs.					
Module:3	Refrigeration system components	6 hours			
Classifications of compressors, performance characteristics of reciprocating compressors. Classifications of evaporators & condensers and their characteristics. Expansion devices – capillary tube and thermostatic expansion valves.					
Module:4	Refrigerants	5 hours			
Classification of refrigerants, refrigerant properties, water and lubricating oil compatibility, environmental impact, montreal / kyoto protocols, eco-friendly refrigerants. Refrigeration tools – evacuation and charging unit, recovery and recycling unit, vacuum pumps.					
Module:5	Psychrometry and air-conditioning systems	6 hours			
<p>Composition of moist air, psychrometry – properties, processes and chart. Relation between psychrometric properties, combined heat and mass transfer processes, adiabatic mixing, evaporative cooling, desiccants.</p> <p>Summer air-conditioning systems (hot –wet weather and hot-dry weather), winter air-conditioning systems, all year air-conditioning systems.</p>					
Module:6	Cooling-heating load estimations and control systems	7 hours			
Thermal comfort, infiltration and ventilation, winter heating load estimations, summer cooling load estimations, RSHF, bypass factor. Applications with specified ventilation air quantity, use of ERSHF and GRSHF, application with low latent heat loads and high latent heat loads. Control Systems – selection, types and devices. control based on space temperature,					

outside temperature, cooling-heating medium.			
Module:7	Applications of refrigeration and air-conditioning	5 hours	
Food processing and preservation, freezing and drying, cold storage, refrigerated containers and trucks. Case studies.			
Module:8	Contemporary issues	2 hours	
Total Lecture hours:		45 hours	
Text Books			
1.	Arora C.P, Refrigeration and Air-Conditioning, 2020, Edition:4, McGraw Hill.		
2.	Eugene Silberstein, Refrigeration and Air Conditioning Technology, 2016, Edition:9, Delmar publications.		
Reference Books			
1.	Frank Kreith, Shan K Wang and Paul Norton, Air Conditioning and Refrigeration Engineering, 2019, Edition:1, CRC Press.		
2.	Andrew D. Althouse, Carl H. Turnquist, A.F. Bracciano, D.C. Bracciano, G.M. Bracciano, Modern Refrigeration and Air Conditioning, 2017, Edition:20, Goodheart-Willcox Publications.		
Mode of Evaluation: CAT, Digital Assignment, Quiz, FAT			
Recommended by Board of Studies		09-03-2022	
Approved by Academic Council		No. 65	Date 17-03-2022