University of Sistan and

Baluchestan

Department of Mechanical Engineering

Heating, ventilation, and air conditioning (HVAC)

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COURSE OUTLINE

Mechanical services are at the centre of a building's internal environment and environmental impact. To enable you to take an active part in the design, installation or operation of these services you should both understand the principles and be able to apply technologies. The course will introduce many building engineering systems from water supply, plumbing and drainage, through heating and ventilation systems to more complex systems for air conditioning. It will emphasize the relative merits of different systems and explain the context of current regulatory and professional practice related both to design and maintenance. The course will cover the principles of design and loading calculations for mechanical services, as well as the influence carbon reduction and sustainability has on the selection of plant and systems.

COURSE DETAIL

Module No.	Topic/s	Lectures
۱	**INTRODUCTION AND BASIC CONCEPTS** • Thermodynamics and Energy • Systems and Control Volumes • Processes and Cycles • Temperature and the Zeroth Law of Thermodynamics • The First Law of Thermodynamics • the Second Law of Thermodynamics	۲

٢	**Properties of moist air (psychrometry)** • Composition of moist air • Methods for estimating moist air properties • Important psychrometric properties • Dry bulb temperature • Humidity ratio • Relative humidity • Degree of saturation • Dew point temperature • Enthalpy • Adiabatic saturation • Thermodynamic wet bulb temperature and wet bulb thermometer • Relations between psychrometric properties • Introduction to humidity ratio vs. dry-bulb temperature psychrometric chart and ASHRAE chart • Use of psychrometric charts and moist air tables	٣
٣	**Psychrometric Processes** • Sensible cooling and heating, RSH • Humidification and dehumidification, RLH • Combined heat and mass transfer processes, RTH, RSHF, • Straight line law – coil bypass factor and ADP • Cooling and dehumidification • Heating and humidification • Psychrometric calculations for simple airconditioning system and for return air systems with bypass factor. RSHF, GSHF and ESHF • Cooling and humidification (evaporative cooling) • Adiabatic mixing • Spray washers and cooling towers	٣
٤	**Air conditioning systems for comfort** • Thermal comfort. Heat transfer from human body by sensible and latent heat transfer Metabolic heat generation, steady state and unsteady state model for heat transfer, effect of clothing and definition of effective temperatures. PMV and PPD. ASHRAE comfort chart. • Inside and Outside design conditions • Summer air conditioning systems • Winter air conditioning systems • All year air conditioning systems	٣

٥	**Heating and Cooling load calculations** • Differences between winter and summer load calculations • Solar radiation • Distribution of solar radiation • Direct and diffuse solar radiation • Earth sun angles and their relationship • Solar radiation on horizontal, vertical and inclined surfaces • Solar radiation through glass, SHGF and shading coefficients • Effects of internal and external shading devices • Heat transfer through building structure • Thermal resistance of various building materials • Periodic heat transfer through walls and roof • Governing equations • Methods of solution • Decrement factor and Time lag method • Equivalent Temperature difference Method • Winter heating load calculations • Heat losses through the structure • Heat losses due to infiltration • Effects of solar radiation and internal heat sources on heating loads • Degree day and BIN methods for estimating energy requirements for heating • Summer cooling load calculations • Heat gain through walls and roof • Heat gain through glazings • Cooling Load Factors (CLF) • Heat gain through doors, floor, partition etc. • Internal heat gains • Infiltration and ventilation heat gains • System heat gains (ducts, fans, blowers etc)	٤
٦	**Air conditioning systems** • a) All air systems • b) All water systems • c) Air water systems • d) Unitary systems • Window Air conditioners	٥

REFERENCES

Refrigeration and Air-conditioning /CP Arora, TMG

ASHRAE Handbook (fundamentals), ASHRAE

ADDITIONAL READINGS

Thermodynamics: An Engineering Approach / Yunus Cengel , Michael Boles