TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ARCHITECTURE & BUILT ENVIRONMENT

UNIVERSITY EXAMINATION FOR:

BACHELOR OF ARCHITECTURAL STUDIES/BACHELOR OF ARCHITECTURE

EAR 4212: **BUILDING ENVIRONMENTAL SCIENCE I**

(THERMAL DESIGN)

SPECIAL AND SUPPLEMENTARY EXAMINATION

YEAR TWO SEMESTER II

SERIES: JULY 2025

TIME: 2 HOURS

DATE: Pick DateJuly 2025

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, calculator, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

QUESTION ONE (30 MARKS)-COMPULSORY

a) Explain THREE factors that affect the thermal conductivity of a building material. (6 marks)

b) Explain heat transfer by air movement in buildings (6 marks)

c) Describe the predicted mean vote (PMV) index of thermal comfort. (6 marks)

d) Describe the adaptive thermal comfort concept and model. (12 marks)

QUESTION TWO (20 MARKS)

a) Explain thermal mass of the building envelop and its effect indoor temperature. (8 marks)

b) Describe the thermo regulatory system of the human body. (12 marks)

QUESTION THREE (20 MARKS)

a) Describe FOUR main sources of local thermal discomfort to the human body. (8 marks)

b) With the aid of sketches explain how natural ventilation can be induced in a room to achieve thermal comfort using:

i) Solar chimneys (6 marks)

ii) Venturi effect (6 marks)

QUESTION FOUR (20 MARKS)

Discuss the general strategies of passive thermal comfort design of buildings in hot and dry areas of northern Kenya regarding:

a) Building materials for the building envelop elements (8 marks)

b) Window openings (12 marks)

QUESTION FIVE (20 MARKS)

a) Describe the heat transfer exchanges by radiation in buildings (8 marks)

b) Figure 1 shows the solar path diagram for Nairobi. Calculate the depths of horizontal and vertical sunshades required to shade a north north east (NNE) facing window measuring 1500mm x 1500mm. (12 marks)

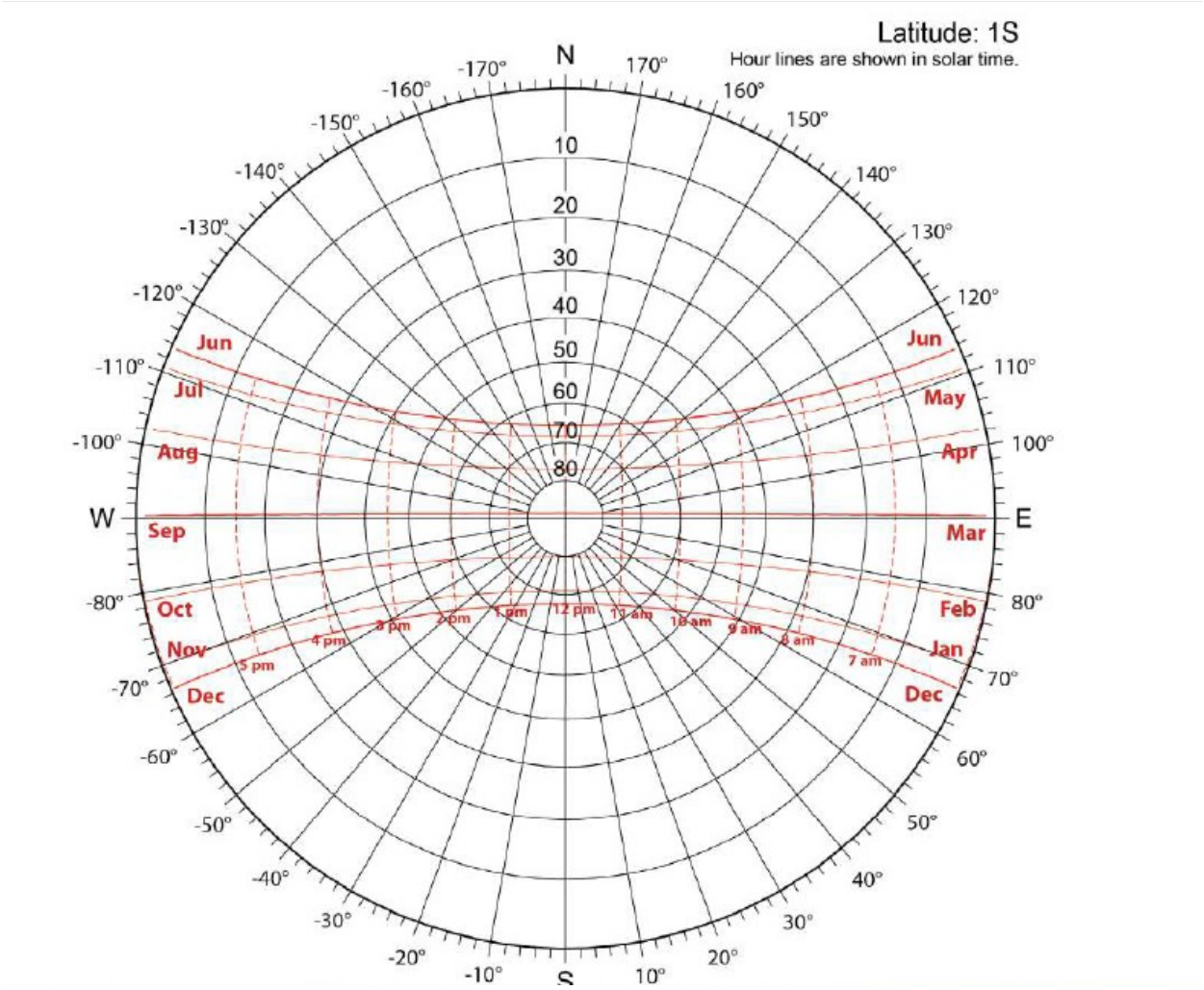

Figure 1. Polar sun path diagram for Latitude 0°