Sylhet Engineering College, Sylhet

(Shahjalal University of Science & Technology)

Department of Civil Engineering

Final Examination, 2024 **2nd Year 2nd Semester**

Course No.: CE 0732 2235 Course Title: Fluid Mechanics

Time: 03 (Three) hours **Full Marks: 60**

N.B. : (i) Answer all questions from each PART (ii) Use separate answer scripts for each PART

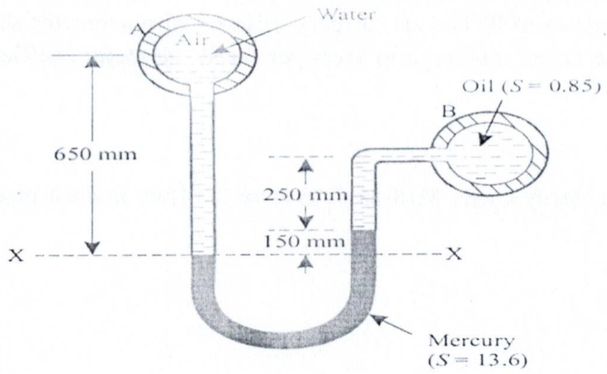
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)----------N/A-------

PART- A

1. **(a)** State Newton's law of viscosity. **02**

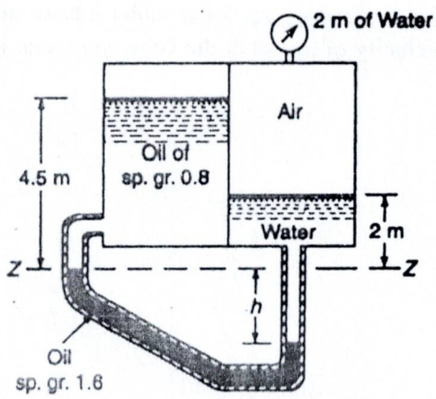
(b) Define fluid mechanics. What are the three branches of fluid mechanics? **02**

(c) A differential manometer connected at two points A and B showed in figure. At A air pressure is 100 kN/m^2. Find the absolute pressure at B. **06**



2. **(a)** State pascal's Law. Explain why the center of pressure is always below the center of gravity of a submerged area. **05**

(b) The compartments of the two tanks are closed and filled as shown in figure. Find the value of h, if the pressure in the left hand tank air is 0.3m of mercury. (Hints: Pressure in the left hand tank above Z-Z datum. **05**



3. **(a)** Short Notes: a) Translation b) Distortion c) Unsteady flow d) Uniform flow **02**

(b) Describe the three forms of energy present in the fluid flow **02**

(c) Drive the equation of continuity for three dimensional steady incompressible flow. **06**

OR

(a) What are the limitations of Bernoulli's theorem? **02**

(b) Write down the physical significance of: i) Reynold's number ii) Froude number iii) Mach number. **02**

(c) For a turbulent flow, explain the term i) Loss due to contraction and ii) Loss due to expansion. For an equivalent condition why expansion loss is greater than contraction loss? **06**

PART- B

4. (a) What does the loss of head occur in pipe flow? Describe different types of losses that occur in pipe flow. **2.5**

   (b) Short notes: a) Tarbulent flow b) Hydraulically Smooth c) Rough Boundaries **1.5**

   (c) Drive the Hazen-Poiseuille equation for laminar flow in a pipe. **06**

5. (a) Define the following terms : (i) Rotation (ii) Stream line **01**

   (b) Express Darcy-Weisbach formula for calculating loss of head due to friction in pipes. **05**

   (c) Drive the Equation flow through a mouthpiece for actual discharge. $Q_a = 0.855A\sqrt{2gh}$ **04**

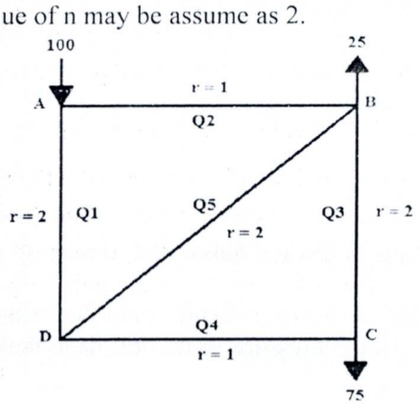
6. (a) Short notes: a) Froude Number b) Euler Number **02**

   (b) Drive the Equation discharge through a large rectangular orifice, $Q = C_d \frac{2}{3}\sqrt{2g}(H_2^{3/2} - H_1^{3/2})$ **04**

   (c) A horizontal Venturi meter having a throat 10 cm in diameter is installed in a 30 cm pipe and is used for measuring the flow of oil specific gravity 0.90.The oil-mercury differential manometer shows a gauge difference of 20 cm. Calculate the actual discharge in liters per sec if the meter coefficient is 0.98. **04**

OR

   (a) A pipe network shown in Fig. By using Hardy Cross Method determine the flow in each pipe. The value of n may be assume as 2. **07**



   (b) A 70 mm diameter orifice is discharging water under a head of 7 m. Calculate the actual discharge in liter per sec and actual velocity of the jet at the vena contracta, if $C_d = 0.63$ and $C_v = 0.97$ **03**

Sylhet Engineering College, Sylhet
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Department of Civil Engineering

Final Examination, 2024 **2nd Year 2nd Semester**

Course No.: CE 0532 2237 Course Title: Engineering Geology & Geomorphology

Time: 02 (Two) hours **Full Marks: 60**

N.B. : (i) Answer all questions from each PART (ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)----------N/A----

PART- A

1. a. What does Engineering Geology study? What are the relationship between Geological Engineering and other engineering sciences **04**
   b. Mention some interface where civil engineers require geological information. **03**
   c. What are Minerals? Briefly describe the compound of minerals with example. **08**

2. a. Define mineral. Classify silicate and non-silicate minerals. Briefly describe any two groups of silicate minerals. **04**
   b. Write short notes on the following properties of minerals: **04**
   (i) Cleavage (ii) Luster (iii) Crystal
   c. What is meant by "Hardness of mineral"? How can it be determined? What is Moh's scale of hardness? **07**

OR

   a. When do Magma and Lava form? **03**
   b. Differentiate between intrusive & extrusive rock. **05**
   c. What is rock cycle? Explain with flow diagram. **07**

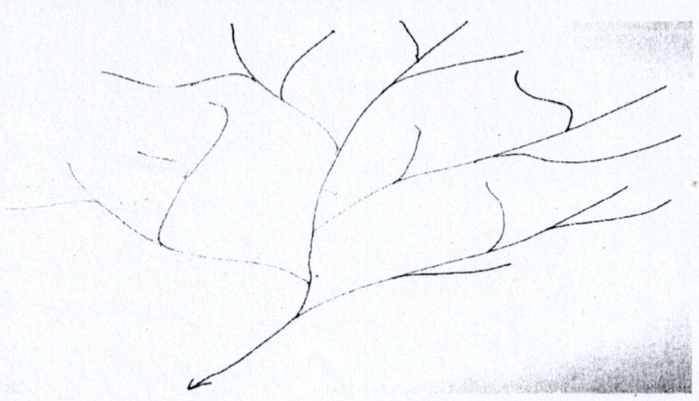
PART- B

3. a. Short Note: 1) Limb 2) Crest and through **03**
   b. What are the types of of Folds that influence the occurrence folding of rocks? Describe four types of Folds. **05**
   c. What types of faults are seen in natural mineral and rocks? Briefly describe five causes & effect of faults. **07**

4. a. What are the major regions based on geological considerations effects of earthquake. **03**
   b. What are the objectives of earthquake study? Briefly describe causes of earthquake. **06**
   c. Briefly describe the types of geological map with example. Define minaraloids. **06**

OR

   a. Short Notes: i) Domes iii) Heave iv) Throw **03**
   b. A drainage area 30000 sq miles of a rectangular shape. The drainage network receives water from this area length of 1st 2nd 3rd 4th 5th 6th order stream is 5.8, 25.3, 71.1, 202.2, 505.8 and 720.4 miles respectively. Length of drainage 225 miles. Find: i) No of streams ii) Average Bifurcation Ratio iii) Average length ratio iv) Drainage Density v) Stream frequency vi) Length of overland flow vii) From Factor viii) Compactness Constant by using Strahler's Ordering. **12**



Sylhet Engineering College, Sylhet
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Department of Civil Engineering

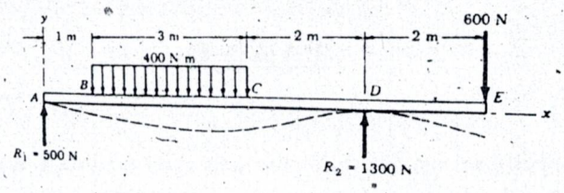
Final Examination, 2024 — **2nd Year 2nd Semester**
Course No.: CE 0732 2231 — **Course Title: Mechanics of Solid II**
Time: 03 (Three) hours — **Full Marks: 60**

N.B. : (i) Answer all questions from each PART (ii) Use separate answer scripts for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)----------N/A------

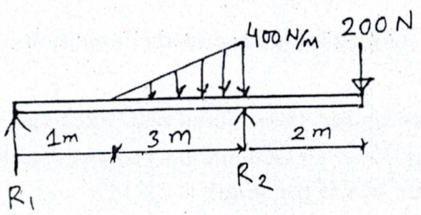
PART- A

1. (a) Define deflection of beam. Derive an expression to determine the deflection of beam by double integration method. **3**

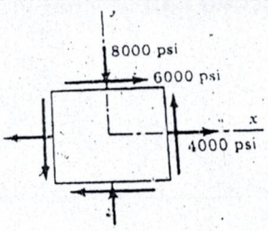
(b) Find the value of Ely at the position midway between the supports and at the overhanging end for the beam shown in the figure below. Use double integration method. **04**



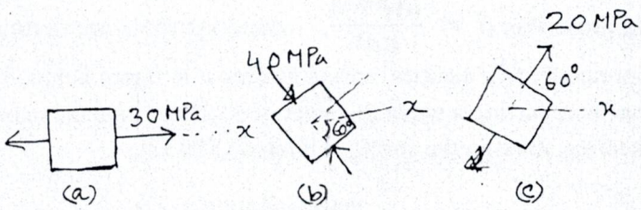
(c) For the beam loaded as shown in figure below compute the moment of area of the M diagrams about the right reaction. **03**



2. (a) If an element is subjected to the state of stress shown in the figure below. Find the principal stresses. Also compute the stress components on a plane at 30^0 counterclockwise from x-face. **05**

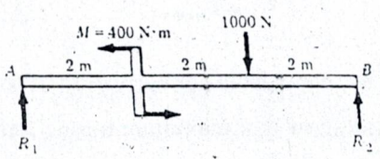


(b) The state of stress at a point is the result of the three separate actions that produce the three states of stress shown in figure below. Determine the principal stresses and principal planes caused by the superposition of these three stress states. **05**

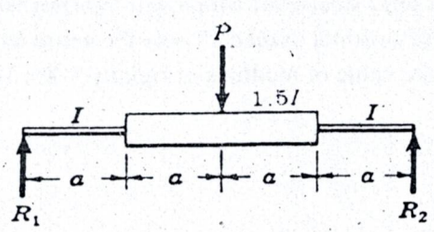


3. (a) Discuss the theorems of Area-Moment Method. **02**

(b) Compute the moment of area of the moment diagram between the reactions about left reaction of the beam shown in the figure below. **03**

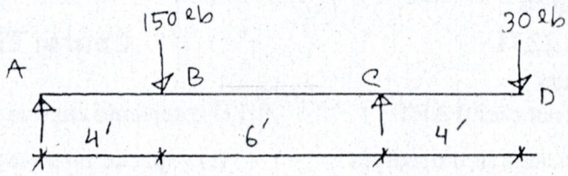


(c) The middle half of the beam shown in figure below has a moment of inertia times that of the rest of the beam. Find the mid span deflection. **05**

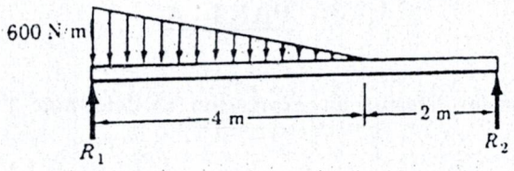


OR **(a)** What are the methods available for determining deflection of beams? **02**

(b) Find the value of δ at D of the following beam shown in the figure below using area-moment method. The modulus of elasticity is E= 3.6×10^6 psi and the cross-section of beam is 10"x10". **03**



(c) Determine the value of EIδ at 4 m from the left support for the beam shown in figure below. **05**



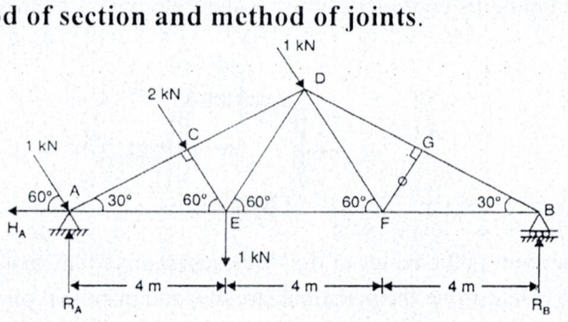
PART- B

4. **(a)** Using AISC column specifications, determine the safe axial load on a $W_{360\text{-}122}$ section used as a column under the hinged end length of column is 9m. use σ_{yp}= 380 MPa and E = 200 GPa. The Section properties are: A = 15500 mm^2 and least r = 63 mm. **05**

(b) Derive Euler's formula for long column. Discuss the limitations of Euler's formula. **05**

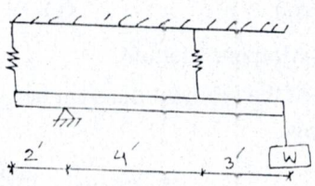
5. **(a)** A 50 mm by 100 mm timber is used as a column with fixed end. Determine the minimum length at which Euler's formula can be used if E = 10 GPa and the proportional limit is 30 MPa. What central load can be carried with a factor of safety of 2 if the length is 2.5 m? **04**

(b) A truss of 12 m span is loaded as shown in Fig. below. Determine the forces in the members DG, DF and EF, using **method of section and method of joints**. **06**



6. **(a)** For a helical spring prove that $\boldsymbol{\delta = \frac{64PR^3n}{Gd^4}}$, where symbols are denoted their usual meaning. **05**

(b) A rigid bar, is supported by two identical spring as shown in figure below. Each spring consists of 20 turns of ¾" diameter wire having a mean diameter of 6". Determine the maximum load W that may be supported if the shearing stress in the spring is limited to 20 ksi. **05**



OR **(a)** What are the assumptions that are considered for derivation of torsion formula of shaft? Derive torsion formula for a circular shaft. Also show that maximum torque transmitted by a solid circular shaft is $\frac{16T}{\pi d^3}$, where the symbols denote usual notations. **05**

(b) Determine the diameter of a solid steel shaft which will transmit 90 kW at 160 r.p.m. Also determine the length of the shaft if the twist must not exceed 1° over the entire length. The maximum shear stress is limited to 60 N/mm^2. Take the value of modulus of rigidity = 8 × 104 N/mm^2. **05**

Sylhet Engineering College, Sylhet
Department of Civil Engineering
B. Sc. (Hons.) 2nd Year 2nd Semester Examination 2024
Course No: MAT 0541 2205, Course Title: Applied Mathematics for Engineers, Credit: 3
Time: 3 hours **Full Marks: 60**

Part-A

1. Define ordinary and singular points. Find the power series solution of the initial value problem 10
$(x^2-1)y'' + 3xy' + xy = 0$; $y(0) = 4$, $y'(0) = 6$.

2. a) Define Fourier series for a function. If the series $A + \sum_{n=1}^{\infty}\left(a_n \cos\frac{n\pi x}{l} + b_n \sin\frac{n\pi x}{l}\right)$ converges uniformly to $f(x)$ in $(-l, l)$, show that for $n = 1,2,3, \ldots$, (i) $a_n = \frac{1}{l}\int_{-l}^{l} F(x)\cos\frac{n\pi x}{l}dx$, (ii) $b_n = \frac{1}{l}\int_{-l}^{l} F(x)\sin\frac{n\pi x}{l}dx$, (iii) $A = \frac{a_0}{2}$. 5

b) How can you define half range sine and cosine series. Expand $F(x) = x, 0 < x < 2$, in a half range (i) sine series, (ii) cosine series. 5

OR

a) What is Fourier Transform? Use finite Fourier transforms to solve the boundary value problem 5
$\frac{\partial U}{\partial t} = \frac{\partial^2 U}{\partial x^2}$; $U_x(0,t) = 0, U_x(6,t) = 0, U(x,0) = 2x$ where $0 < x < 6, t > 0$.

b) Find the Fourier transform of $\frac{e^{-ax}}{x}$. 5

3. a) Write down the Legendre's differential equation. Show that $\int_{-1}^{1} P_m(x)P_n(x)dx = 0$ if $m = n$ and the symbols have their usual meanings. 5

b) Show that (i) $J_{-\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}}\cos x$, (ii) (i) $J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}}\sin x$ and 5
(iii) $\left(J_{-\frac{1}{2}}(x) + J_{\frac{1}{2}}(x)\right)^2 = \frac{2}{\pi x}$, where the symbols have their usual meanings.

Part-B

4. a) Define the following terms: i. The frequency based definition of probability, ii. Probability space. 2

b) A random variable X has the following probability function: 5

Values of X:x	0	1	2	3	4	5	6	7	8
f(x)	a	3a	5a	7a	9a	11a	13a	15a	17a

i. Determine the value of a. ii. Find P[X<3], P[X ≤ 3], and P[0<X<5].

c) If X is a discrete random variable with probability function 3

Values of X:x	1	2	3	4	5	6
f(x)	1/6	1/6	1/6	1/6	1/6	1/6

Find the variance and standard deviation of the distribution.

OR

a) Prove that normal distribution represents a valid probability density function. 2

b) Derive the poisson distribution, and demonstrate that its mean is equal to its variance. 5

c) In a multiple choice test, a student randomly guesses the answer to 10 questions. Each question has possible answers, only one of which is correct. 3

(i) Find the probability that the student answers exactly 3 questions correctly.

(ii) Find the probability that the student answers at most 2 questions correctly.

5. a) What is meant by correlation? Describe its types with figures. 2

b) Derive Pearson's correlation coefficient. 4

c) To analyze the relationship between the applied voltage (V) and the resulting current (I) in a resistive circuit, the observed data are presented in the table below: 4

Observation	Voltage V (Volts)	Current I (Amperes)
1	5	0.30
2	10	0.65
3	15	1.20
4	20	1.13
5	25	2.56
6	30	4.23
7	35	3.11
8	40	3.12

Compute Karl Pearson's correlation coefficient between V and I, and provide an interpretation of the result.

6. a) What is regression analysis? Write down a simple linear regression model explaining each term of the model. 3

b) Japan faces serious waste-management problems due to its high population density. A study published in *Water Research* (1999) introduced a new machine for compressing sewage sludge. The study examined the relationship between filtration rate (x, kg-DS/m/hr) and moisture content of the pellets (y, %): 7

X:	125.3	98.2	201.4	147.3	145.9	124.7	112.2	120.2	161.2	178.9
Y:	77.9	76.8	81.5	79.8	78.2	78.3	77.5	77.0	80.1	80.2
X:	159.5	145.8	75.1	151.4	144.2	125.0	198.8	132.5	159.6	110.7
Y:	79.9	79.0	76.7	78.2	79.5	78.1	81.5	77.0	79.0	78.6

Using the data extracted from the article, fit a simple linear regression model and estimate the moisture content when the filtration rate is 120 kg-DS/m/hr.

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Final Examination, 2024 — **2nd Year 2nd Semester**
Course No.: CE 0532 2223 — **Course Title: Engineering Hydrology**
Time: 02 (Two) hours — **Full Marks: 60**

N.B. : (i) Answer all questions from each PART (ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)----------N/A----------

PART- A

1 **(a)** Define and describe the hydrologic cycle with schematic diagram. **04**

(b) A catchment area of 140 km^2 received 120 cm of rainfall in a year. At the outlet of the catchment, the flow in the stream draining the catchment was found to have an average rate of (i) 1.5 m^3/s for the first 3 months, (ii) 2.0 m^3/s for 6 months and (iii) 3.5 m^3 /s for the remaining 3 months. (a) What is the runoff coefficient of the catchment? (ii) If the afforestation of the catchment reduces the runoff coefficient to 0.35, what is the increase in the abstraction from precipitation due to infiltration, evaporation and transpiration for the same annual rainfall of 120 cm? **08**

(c) Mention application of Hydrology in engineering. **03**

2 **(a)** Define: Infiltration, Infiltrometer, and Infiltration Index. What factors affect infiltration capacity? What is infiltration model equation? 05

(b) Calculate the potential evapotranspiration from an area near Sylhet in the month of November by Penman's formula. The following data are available: 08

Latitude	:28°4′N
Elevation	:230 m (above sea level)
Mean monthly temperature	:19° C
Mean relative humidity	:75%
Mean observed sunshine hours	:9 h
Wind velocity at 2 m height	:85 km/day
Nature of surface cover	:Close-ground green crop

[Extract necessary data from tables at the bottom of the question.]

(c) Mention characteristics of Precipitation in the Subcontinent shortly. 02

OR

3. **(a)** Define: overland flow, surface runoff, interflow, prompt interflow, delayed interflow, Base flow **05**

(b) A catchment area shown in figure below this question. the details of Thiessen polygons surrounding each raingauge and the recordings of the raingauges in the month of August 2011 are given below. Determine the average depth of rainfall on the basin in August 2011 by (i) arithmetic mean method, and (ii) Thiessen mean method. **08**

Raingauge Station	1	2	3	4	5	6
Thiessen polygon area (km2)	720	380	440	1040	800	220
Recorded rainfall in mm during Aug. 2011	121	134	145	126	99	115

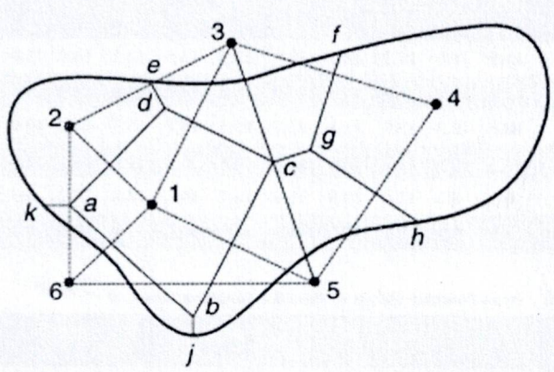

Fig: Theissen polygon

(c) A bridge has an expected life of 25 years and is designed for a flood magnitude of return period 100 years. (a) What is the risk of this hydrologic design? (b) If a 10% risk is acceptable, what return period will have to be adopted? **02**

PART- B

3. **(a)** Describe briefly the SCS-CN method of estimation of yield of catchment through use of daily rainfall record. **06**

(b) What is a hydrological drought? What are its components and their possible effects? **06**

(c) What is unit hydrograph? What is the application of unit hydrograph? What are the limitations of unit hydrograph? **03**

4. **(a)** Explain distribution of soil moisture in infiltration process through different zones. **05**

(b) Details related to an isolated 6-hour storm that occurred over a catchment are given. Estimate the runoff from the catchment due to the storm. **07**

Sub Area	Areal Extent of sub area as % of catchment	φ-index	Rainfall (cm)		
			First 2-hours	Second 2-hours	Third 2-hours
A	.025	0.3	0.80	1.60	1.30
B	0.45	0.5	0.90	1.40	1.10
C	0.30	0.4	0.86	1.30	0.90

(c) Why estimation of vapour is necessary? **03**

OR

(a) What is flood forecasting? Describe various techniques of flood forecasting. **05**

(b) Describe Area velocity method for streamflow measurement. **07**

(c) Briefly describe different types of Stream Ordering **03**

Table 3.3 *Saturation Vapour Pressure of Water*

Temperature (°C)	Saturation vapour pressure e_w (mm of *Hg*)	Δ (mm/°C)
0	4.58	0.30
5.0	6.54	0.45
7.5	7.78	0.54
10.0	9.21	0.60
12.5	10.87	0.71
15.0	12.79	0.80
17.5	15.00	0.95
20.0	17.54	1.05
22.5	20.44	1.24
25.0	23.76	1.40
27.5	27.54	1.61
30.0	31.82	1.85
32.5	36.68	2.07
35.0	42.81	2.35
37.5	48.36	2.62
40.0	55.32	2.95
45.0	71.20	3.66

$e_w = 4.584 \exp\left(\frac{17.27t}{237.3+t}\right)$ mm of *Hg*, where t = temperature in °C.

Table 3.4 *Mean Monthly Solar Radiation at Top of Atmosphere, H_a in mm of Evaporable Water/Day*

North latitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0°	14.5	15.0	15.2	14.7	13.9	13.4	13.5	14.2	14.9	15.0	14.6	14.3
10°	12.8	13.9	14.8	15.2	15.0	14.8	14.8	15.0	14.9	14.1	13.1	12.4
20°	10.8	12.3	13.9	15.2	15.7	15.8	15.7	15.3	14.4	12.9	11.2	10.3
30°	8.5	10.5	12.7	14.8	16.0	16.5	16.2	15.3	13.5	11.3	9.1	7.9
40°	6.0	8.3	11.0	13.9	15.9	16.7	16.3	14.8	12.2	9.3	6.7	5.4
50°	3.6	5.9	9.1	12.7	15.4	16.7	16.1	13.9	10.5	7.1	4.3	3.0

Table 3.5 *Mean Monthly Values of Possible Sunshine Hours, N*

North latitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0°	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1
10°	11.6	11.8	12.1	12.4	12.6	12.7	12.6	12.4	12.9	11.9	11.7	11.5
20°	11.1	11.5	12.0	12.6	13.1	13.3	13.2	12.8	12.3	11.7	11.2	10.9
30°	10.4	11.1	12.0	12.9	13.7	14.1	13.9	13.2	12.4	11.5	10.6	10.2
40°	9.6	10.7	11.9	13.2	14.4	15.0	14.7	13.8	12.5	11.2	10.0	9.4
50°	8.6	10.1	11.8	13.8	15.4	16.4	16.0	14.5	12.7	10.8	9.1	8.1