SOLUTION OF HW2

1)

Day	ET (mm)	Rainfall (mm)
1	12	
2	8.5	
3	10.0	35.7
4	7.0	7.0
5	6.5	25.5
6	6.0	
7	8.0	
8	9.8	
9	4.0	13.5
10	7.0	
11	7.0	
12	8.6	
13	10.0	
14	12.0	
15	9.0	
16	7.0	
17	7.0	
18	6.5	4.3
19	5.0	18.76
20	2.0	41.2
21	6.5	
22	6.0	
23	7.5	
24	9.0	
25	10.4	
26	9.5	
27	11.1	
28	5.3	12.4
29	6.3	
30	2.5	
	$\Sigma ET = 227$ mm	$\Sigma R = 158.36$ mm

ΣAvailable water in soil = $\Sigma R - \Sigma ET = 158.36 - 227 = -68.64$ mm

$\therefore$ 68.64 mm irrigation water must be supplied.

2)

Day	ET (mm)	R (mm)	H_2O Deficit	Initiate Irrigation
1	12		12	
2	8.5		20.5	
3	10.0	35.7	0	
4	7.0	7.0	0	
5	6.5	25.5	0	
6	6.0		6.0	
7	8.0		14.0	
8	9.8		23.8	>22.28 Irrigate
9	4.0	13.5	0	
10	7.0		7.0	
11	7.0		14.0	
12	8.6		22.6	>22.28 Irrigate
13	10.0		10.0	
14	12.0		22.0	
15	9.0		31.0	>22.28 Irrigate
16	7.0		7.0	
17	7.0		14.0	
18	6.5	4.3	16.2	
19	5.0	18.76	2.44	
20	2.0	41.2	0	
21	6.5		6.5	
22	6.0		12.5	
23	7.5		20.0	
24	9.0		29.0	>22.28 Irrigate
25	10.4		10.4	
26	9.5		19.9	
27	11.1		31.0	>22.28 Irrigate
28	5.3	12.4	0	
29	6.3		6.3	
30	2.5		8.8	

Soil water capacity = 10.8 cm/m
RAW = 0.75 AW = 0.75 * 10.8 = 8.1 cm/m
For Irrigation = 0.5 * RAW = 4.05 cm/m
Available water for crop use = 4.05 * 0.55 = 2.228 cm = 22.28 mm.
When H_2O Deficit > 22.28 cm, Initiate irrigation

3)

Location 40^0 Latitude
For 1980 a = 1.195
For 1981 a = 1.175

Month	1980 T ^{0}C	i	$L_d/12$	PET(cm)	1981 T^0C	i	$L_d/12$	PET(cm)
June	18.20	7.071	1.25	9.7	20.30	8.343	1.25	8.5
July	22.40	9.686	1.225	8.4	21.60	9.165	1.225	8.1
Aug.	22.70	9.881	1.15	7.8	20.30	8.343	1.15	7.8

Most important parameter effecting PET is the monthly average temperature values.

4) Use Average temperatures of 1980 and 1981 of June, July and August

$t_{june} = (18.2+20.3)/2 = 19.25$
$t_{july} = (22.4+21.6)/2 = 22$
$t_{Aug} = (22.7+20.3)/2 = 21.5$

Month	t	P	f	k_1	k_2	k	u =25.4 x k x f (mm)
June	19.25	9.95	6.632	0.8	0.46	0.37	62.3
July	22	10.10	7.232	0.8	1.46	1.17	214.9
August	21.5	9.47	6.695	0.8	1.63	1.30	221.1

5) T_{max} = 28.3 ^{0}C, T_{min} = 17.2 ^{0}C, and T_{mean}= T_a= 22.75 ^{0}C , $\frac{n}{N}$=0.5

v_6 = 13 km/h at h = 6 m v_6=13 x 24 = 312 km/d

$$PET = \left(\frac{1}{L}\right)\left(\frac{\Delta}{\Delta+\gamma}\times R_n + \frac{\gamma}{\Delta+\gamma}(15.36)(1+0.0062v_2)(e_s - e_d)\right)$$

L = 595 – 0.51 T_{mean}= 595-0.51x22.75= 583.4 cal/g

γ = 386/583.4 = 0.662

$$v_2 = v_h \ln(2)/\ln(h) = 312\cdot\ln(2)/\ln(6) = 120.7 km/d$$

α for vegetation is about 0.22 (grass-clipped)

σ = 11.71x10^{-8} cal/cm^2-d

R_{se} can be estimated from Table 5.5 $\Rightarrow$ R_{se} = 975 for latitude 30^0 North,

e = 33.86 ((7.38x10^{-3} x T+0.807)^8–1.9x10^{-5} (1.8 xT+48) +1.32x10^{-3}) = 28.89 mb

Using T=T_a=22.75 ^{0}C e = e_s = 27.615 mb

T = T_{min}=17.2 ^{0}C e = e_d = 19.592 mb

Δ =de_a/dT = 2 (7.38 x 10^{-3}T + 0.807)^7 – 1.16 x 10^{-3} ,

Δ = 2 (7.38 x 10^{-3} x 22.75 + 0.807)^7 -1.16 x 10^{-3} = 1.673

$$\frac{\Delta}{\Delta+\gamma} = \frac{1.673}{1.673+0.662} = 0.716$$

$$\frac{\gamma}{\Delta+\gamma} = 1-0.716 = 0.284$$

$$R_n = R_{se}(1-\alpha)\left(0.18+\frac{0.55n}{N}\right) - \sigma T_a^4\left(0.56-0.08\sqrt{e_d}\right)\left(0.10+\frac{0.9n}{N}\right)$$

$$R_n = 975(1-0.22)(0.18+0.55\cdot 0.5) - 11.71\cdot 10^{-8}\cdot(22.75+273)^4\left(0.56-0.08\sqrt{19.592}\right)(0.10+0.9\cdot 0.5)$$

R_n = 244.57 $\frac{cal}{cm^2-day}$

and

$$\left(\frac{\gamma}{\Delta+\gamma}\right)15.36(1+0.0062\ x\ v_2)(e_s-e_d) = (0.284x15.36)(1+0.0062x120.7)(27.615-19.592)$$

=61.189

$$PET = \left(\frac{1}{583}\right)((0.716)(244.57)+61.189) = 0.41\frac{cm}{day}$$