Problem 1 – Solution

a) Not correct
b) Correct
c) Inconclusive
d) Correct
e) Not correct
f) Inconclusive
g) Not correct
h) Correct
i) Inconclusive
j) Incorrect

Problem 2 - Solution

a) Correct
b) Correct
c) Correct. Answer is same as in b) because the spectrum is mirrored.
d) Inconclusive (frequency range needs to be defined).
e) Inconclusive
f) Inconclusive
g) Incorrect
h) Correct
i) Inconclusive
j) Incorrect

Problem 3 – Solution

a) Incorrect
b) Inconclusive (depends on scale)
c) Correct
d) Correct
e) Incorrect
f) Inconclusive (depends on application)

g) $1 + 2\cos(u) + 2\cos(2v) + 2\cos(u+2v) + 2\cos(u-2v)$
The underlined pixels in the second column will preserve their values. The underlined pixels in column 6-7 becomes 21/9 and 24/9, respectively

Problem 4 – Solution

00000001111100
01111111111100
01111111100000
01111111100000
00000000000000

The max filter dilates bright structures

00000000000000
00000000000000
00001111110000
00000000000000
00000000000000

The min filter shrinks bright structures

00000001100000
00000001100000
00000001100000
00000001100000

The range filter acts as an edge detector.

d) Correct
e) Inconclusive (depends on application)
f) Incorrect
g) Correct

Problem 5 – Solution

a) For both objects, the x-coordinate of the center-of-gravity aligns with mid-position of the object. We may then consider the objects as being aligned with origo and compute $m_{2,0}$ rather than $u_{2,0}$.

Small object: $m_{2,0} = 2$ (computed as $2 * 1^2$).
Normalization factor equals $6^2 = 36$. Scale invariant moment then takes the value 2/36 = 1/18 =0.0555.

Large object : $m_{2,0} = 192$ (computed as $2 * (9 * 1^2 + 3 * 2^2 + 3 * 3^2 + 3 * 4^2)$.
Scale invariant central moment then takes the value $192/45^2 = 0.0948$.

b) In order to get the same results, you need to consider the continuous case and compute the moments by integrals.

c) Incorrect

d) Correct

e) Correct

f) Correct

Problem 6 – Solution

a) Inconclusive.
b) Incorrect, it may give more than one solution (but if so, both are global solutions, not local traps).
c) Inconclusive.
d) Incorrect.
e) Correct (notice that the object is darker than the background, otherwise it would have been the other way around).
f) Incorrect, point-wise subtraction between the input image and a small local average is identical to LaPlacian filtering
g) Inconclusive
h) Incorrect
i) Incorrect
j) Any answer is considered OK – Merry Christmas