**Special Assigment**

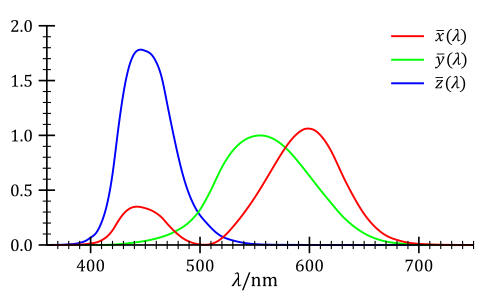
**ZCE 111**

**First Part: Planckian locus**

Read Planckian locus on <https://en.wikipedia.org/wiki/Planckian_locus>

In the [CIE XYZ color space](https://en.wikipedia.org/wiki/CIE_1931_color_space), the three coordinates defining a electromagnetic spectrum are given by :

where *M(λ,T)* is the [spectral radiant exitance](https://en.wikipedia.org/wiki/Spectral_radiant_exitance) of the light being viewed, andare the [color matching functions](https://en.wikipedia.org/wiki/Color_matching_function) of the CIE [standard colorimetric observer](https://en.wikipedia.org/wiki/Standard_colorimetric_observer), shown in the diagram illustration 1, and *λ* is the wavelength.

Illustration 1: CIE color matching functions.

The Planckian locus is determined by substituting into the above equations the black body spectral radiant exitance, which is given by [Planck's law](https://en.wikipedia.org/wiki/Planck's_law):



where:

*c*1 = 2π*hc*2 is the [first radiation constant](https://en.wikipedia.org/wiki/Planck's_law" \l "First_and_second_radiation_constants)

*c*2 = *hc/k* is the [second radiation constant](https://en.wikipedia.org/wiki/Planck's_law" \l "First_and_second_radiation_constants)

and

*M* is the black body spectral radiant exitance (power per unit area per unit wavelength: watt per square meter per meter (W/m3))

*T* is the [temperature](https://en.wikipedia.org/wiki/Temperature) of the black body

*h* is [Planck's constant](https://en.wikipedia.org/wiki/Planck's_constant)

*c* is the [speed of light](https://en.wikipedia.org/wiki/Speed_of_light)

*k* is [Boltzmann's constant](https://en.wikipedia.org/wiki/Boltzmann's_constant)

This will give the Planckian locus in CIE XYZ color space. If these coordinates are *XT*, *YT*, *ZT* where *T* is the temperature, then the CIE chromaticity coordinates will be

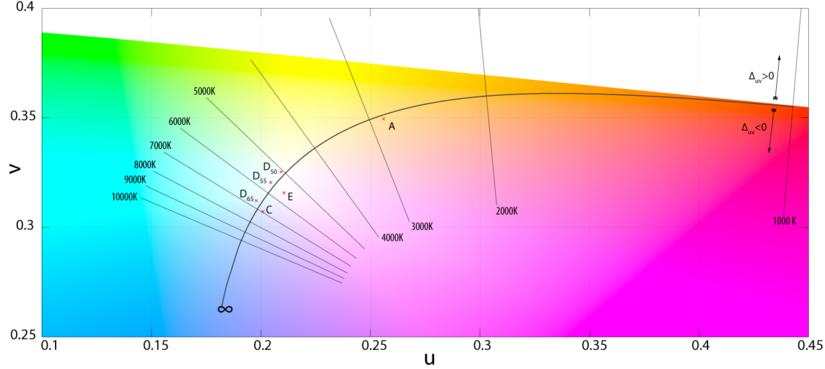




A pair of crhomatocity coordinates (*x,y*) can be exprssed in MacAdam's chromaticity scale (*u,* *v*) as



A Planckian locus can be mapped out in the (*u*,*v*) chromaticity space, see Illustration 2.

Illustration 2: Plackian locus in (u,v) chromatocity space

**Task No.1 to perform:** Given the CIE color matching functions data, write a code to automatically generate the Plackian locus in (*u*,*v*) space as shown in Ilustration 2. The numerical data file for the [color matching functions](https://en.wikipedia.org/wiki/Color_matching_function) can be downloaded from <http://comsics.usm.my/tlyoon/teaching/ZCE111_1516SEM2/data/StdObsFuncs.xls> (as an Excel file).

**Second Part: Correlated Color temperature (CCT)**

Read CCT on <https://en.wikipedia.org/wiki/Color_temperature>

The tristimulus values (X,Y,Z) for a colour with a [spectral power distribution](https://en.wikipedia.org/wiki/Spectral_power_distribution)

are given in terms of:

where  is the wavelength of the equivalent [monochromatic](https://en.wikipedia.org/wiki/Monochromatic) light (measured in [nanometers](https://en.wikipedia.org/wiki/Nanometers)). In practice, is a spectrum measured experimentally, e.g., that emitted from a LED light bulb.

**Task No. 2 to perform:** Download the numerical data of a spectrum from <http://comsics.usm.my/tlyoon/teaching/ZCE111_1516SEM2/data/spectral_power_distribution.dat>. Note that the numerical data foris expressed in SI unit (in particular the wavelength values (in the first column) is in unit of meter).

Modify your code from **Task No. 1** to obtain the chromatocity coordinates for the spectrum . Call it .

(a) CCT *=* ??K

**Answer**:

**Task No. 3 to perform:** Extent your code to do the following: Identify a point on the Planckian locus at which the normal line at that point pass through . Identify the temperature corresponds to the Planckian locus point. This temperature is the CCT of the spectrum .

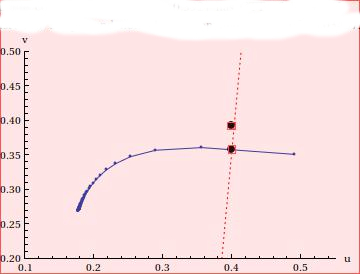
**Answer**:5259.3 K

**Task No. 4 to perform:** Output a diagram displaying (i) the Planckian curve, (ii) the point , (iii),(iii) the normal line that passes through both and , see the sample output below.

Note:

1. Make sure that your code must output explicitely (a) the values of the CCT for, (b) thedot, (c) thedot, (d) the Planckian locus and (e) the normal line.

2. Your code should be fully automatic and should produce all the required output at a press of a button wihtout any manual intervention (except the act of pressing the shift+enter burron keys).

Illustration 3: Sample output of your diagram

*Cs*(*us*,*v****s***)

(e) Normal line

(c) *PN*(*uN*,*v****N***)

(d) Planckian locus

*Cs*(*us*,*v****s***)

(b) *Cs*(*us*,*v****s***)