a)
SQL QUERY

```
SELECT
SpecObj.plate, SpecObj.mjd, SpecObj.fiberid,
GalSpecLine.oiii_5007_flux, GalSpecLine.h_beta_flux, GalSpecLine.h_gamma_flux,
GalSpecLine.oiii_5007_cont, GalSpecLine.h_beta_cont, GalSpecLine.h_gamma_cont,
GalSpecLine.oiii_5007_eqw, GalSpecLine.h_beta_eqw, GalSpecLine.h_gamma_eqw,
GalSpecinfo.e_bv_sfd,
GalSpecLine.oiii_5007_flux/GalSpecLine.h_beta_flux AS ratio_oiii_hb,
GalSpecLine.oiii_5007_flux/GalSpecLine.h_gamma_flux AS ratio_oiii_hg


FROM SpecObj, GalSpecLine, GalSpecinfo

WHERE
SpecObj.specobjid = GalSpecLine.specobjid
AND SpecObj.specobjid= GalSpecinfo.specObjID
AND GalSpecLine.h_beta_flux >0
AND GalSpecLine.oiii_5007_flux>0
AND GalSpecLine.h_gamma_flux>0
AND GalSpecLine.sigma_balmer>1000
AND (SpecObj.class = 'QSO' OR SpecObj.class = 'GALAXY')
AND SpecObj.z BETWEEN 0.05 AND 0.3
AND SpecObj.snmedian_g >35
```

This is the SQL satisfying all the conditions given in problem (a).

GalSpecLine.oiii_5007_flux/GalSpecLine.h_beta_flux AS ratio_oiii_hb,
GalSpecLine.oiii_5007_flux/GalSpecLine.h_gamma_flux AS ratio_oiii_hg finds the flux ratios of the respective lines. I had to add the following commands
AND GalSpecLine.h_beta_flux >0
AND GalSpecLine.oiii_5007_flux>0
AND GalSpecLine.h_gamma_flux>0
in the WHERE condition because otherwise I was getting an error that there was a division by 0. Presumably there were some) fluxes in the denominator.

There is a condition that FWHM (H beta line) >1000 km/s.
Now on searching FWHM of H beta line on schema I found that under The SPIDERS quasar eRosita source there are multiple fwhm of hb lines given. However whether the unitrs for these are km/s is not mentioned. Additionally I couldn't find a way to match the SPIDERS quasar eRosita sourceid to GalSpecLine, Galspecinfo or SpecObj.

errwidth1_hb	real	4			Uncertainty in the width of the first Gaussian used to fit the H beta line.
fwhm1_hb	real	4			FWHM of the first Gaussian used to fit the H beta line.
errfwhm1_hb	real	4			Uncertainty in the FWHM of the first Gaussian used to fit the H beta line.

The SPIDERS quasar eRosita source shown above.

So I used **AND GalSpecLine.sigma_balmer>1000.** But the table mentiones that this is not FWHM but velocity dispersion.

name	type	length	unit	ucd	description
specObjID	bigint	8		ID_CATALOG	Unique ID
sigma_balmer	real	4	km/s		Velocity dispersion (sigma not FWHM) measured simultaneously in all of the Balmer lines
sigma_balmer_err	real	4	km/s		Error in the above

RESULTS IN Skyserver_SQL3_18_2023 10 48 32 AM.csv

b) Adding this condition also gives zero results. Because all of these conditions are not satisfied by any Galaxy or Quaser.

SELECT count(*)

FROM SpecObj, GalSpecLine, GalSpecinfo

WHERE
SpecObj.specobjid = GalSpecLine.specobjid
AND SpecObj.specobjid= GalSpecinfo.specObjID
AND GalSpecLine.h_beta_flux >0
AND GalSpecLine.oiii_5007_flux>0
AND GalSpecLine.h_gamma_flux>0
--AND GalSpecLine.sigma_balmer>1000
AND (SpecObj.class = 'QSO' OR SpecObj.class = 'GALAXY')
AND SpecObj.z BETWEEN 0.05 AND 0.3
AND SpecObj.snmedian_g >35

Group by SpecObj.class

Without the FWHM condition, I obtained 438 objects, 157 QSO and 281 Galaxies.
I removed this condition and then proceeded.
Without the conditions that flux>0, I got 531 objects 159 QSO and 372 Galaxies.
Since we are calculating flux ratios, I kept the conditions that flux>0 and removed the condition on redshift to get 342 quasers and 4706 galaxies.
If i removed the S/N condition I get 10736 QSO and 509326 Galxies.

So we can see that S/N ratio removes most of the canditates followed by redshift.

(c)

SELECT
SpecObj.plate, SpecObj.mjd, SpecObj.fiberid,
GalSpecinfo.subclass

FROM SpecObj, GalSpecLine, GalSpecinfo

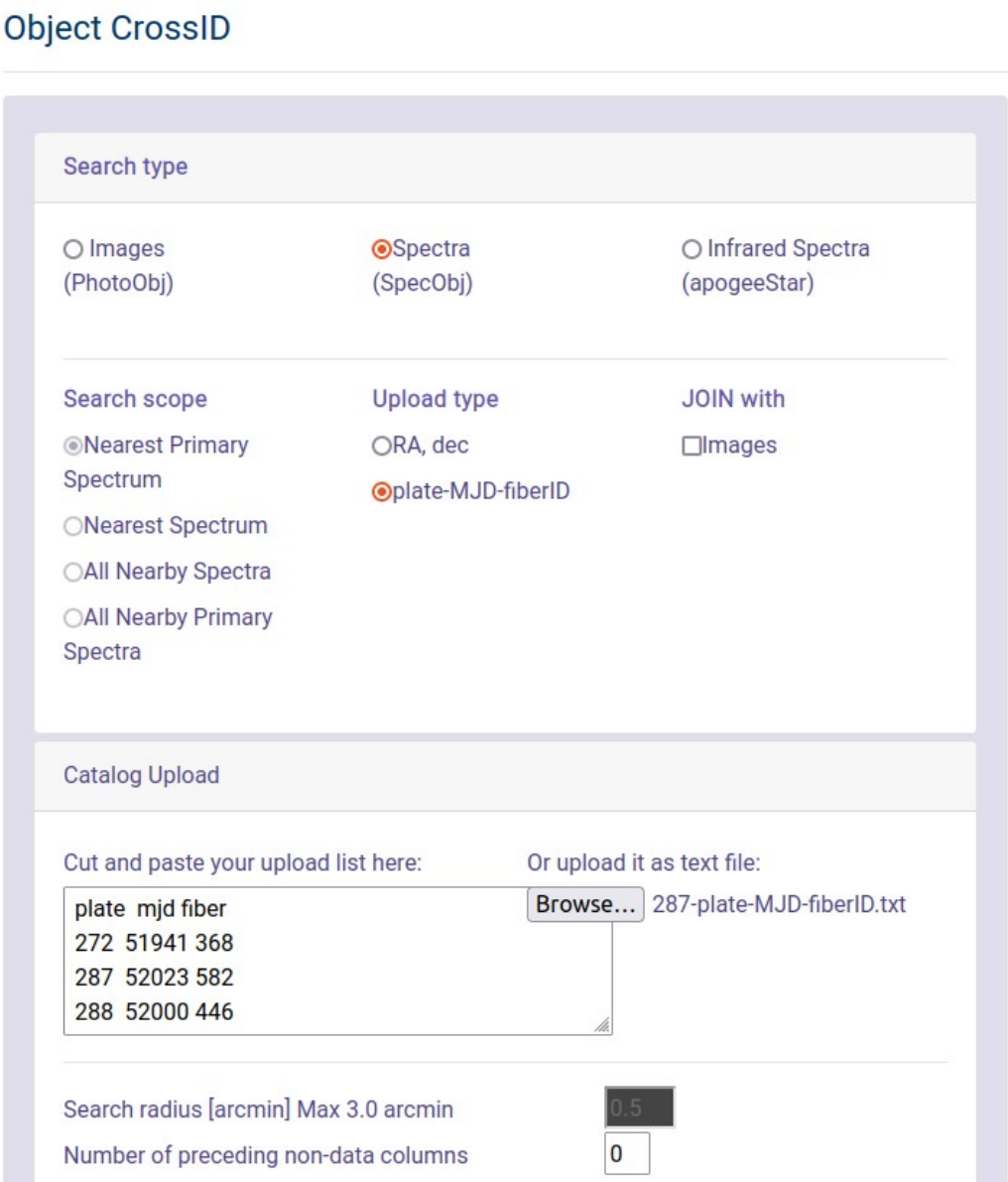
WHERE

SpecObj.specobjid = GalSpecLine.specobjid
AND SpecObj.specobjid= GalSpecinfo.specObjID
AND GalSpecLine.h_beta_flux >0
AND GalSpecLine.oiii_5007_flux>0
AND GalSpecLine.h_gamma_flux>0
--AND GalSpecLine.sigma_balmer>1000
--AND (SpecObj.class = 'QSO' OR SpecObj.class = 'GALAXY')
AND SpecObj.z BETWEEN 0.05 AND 0.3
AND SpecObj.snmedian_g >35

Gives the subclasses as mentioned in the description “Schlegel subclass from PCA analysis -- not alwasy correct!! AGN/BROADLINE/STARBURST/STARFORMING”

RESULTS IN Skyserver_SQL3_18_2023 10 54 23 AM.csv

(d)
Crossing SQL query with the given text file as follows



Crossmatch SQL Query

Type your SQL query here (see below for help):

```
SELECT count(*)
--s.specobjid, s.ra, s.dec, s.plate, s.mjd, s.fiberid
FROM #upload u
    JOIN SpecObj s ON (s.plate=u.up_plate AND s.mjd=u.up_mjd AND s.fiberID=u.up_fiber)
WHERE
--s.z BETWEEN 0.05 AND 0.3
s.snmedian_g >35
```

Without any condtions on z and S/N, the crossmatch gives 177 matches.
With a S/N condition, the crossmatch gives 39 matches
Using redshift condition, there are no matches.

The result for the crossmatch without any condition on z and S/N is given in Skyserver_CrossID3_18_2023 11 56 53 AM.csv

(e)
Spectrum obtained for the following

plate	mjd	fiberid
1943	53386	466
541	51959	600
1002	52646	237

The code and plots and in the Spectrum PDF attached.