Question 1:

(a) Return classname, examname and examdate of all exams with examdate after November 1st of 2020 that the instructor named Fogg is giving.

T1 = select_ {examdate > 11-01-2020} (Exams)
T2 = select_ {instructor == 'Fogg'} (Teaches)
Result = project_{classname, examname, examdate}(T1 * T1 * Classes)

(b) Return classcode, dayofweek and startime of class meetings that conflict with an office hour for the same class.

Result = project_{classcode, dayofweek, startime} {Officehours} intersect project_{classcode, dayofweek, startime} (Classmeetings)

(c) Return classcode, classname of all classes that meet on mondays (dayofweek).

T1(classcode1, classname, semester, year, credits) = Classes
T2 = select_{classcode1 = classcode and dayofweek = Monday} (T1 X Classmeetings)
Result = project_{classcode, classname} (T2)

(d) Return the username and best browser for all sites to be used for hw in a class taught in Fall 2000 (classes. semester, classes.year)

T1 = select_{resourcetype = 'hw'} (Resources * (select_{semester = Fall, year = 2000} (Classes)))

T2(sitename1, username1, password, bestbrowser) = Sites

Result = project_{username, bestbrowser} (select_{sitename1 = sitename} (T1 * T2))

(e) Find the sitename of all sites used in at least one class for class meetings, exams, office hours or other resources

T1 = project_{sitename}(Classmeetings)

T2 = project_{sitename}(Exams)

T3 = project_{sitename}(Officehours)

T4 = project_{sitename}(Resources)

result = T1 union T2 union T3 union T4

(f) Find the name of a pair of courses that have no sites in common for any activity

T1 = project_{classcode, sitename}(Officehours)

T2 = project_{classcode, sitename}(Classmeetings)

T3 = project_{classcode, sitename}(Exams)

T4 = project_{classcode, sitename}(Resources)

T5 = T1 union T2 union T3 union T4

T6(classcode1, sitename1) = T5

T7 = select_{sitename <> sitename1} (T5 * T6)

Result = project_{classcode, classcode1} (T7)

(g) Find the code and name of courses with a single instructor in the database.

T1 = project_{classcode, instructorname} (Teaches)

T2(classcode1, instructorname1) = T1

T3 = select_{classcode = classcode1 and instructorname <> instructorname1} (T1 * T2)

T4 = project_{classcode} (T1) – project_{classcode} (T3)

Result = T4 * project_{classcode, classname} (Classes)

(h) Return the course code of all courses in Fall 2000 with at least one office hours that are not on Monday and not on Wednesday. Return also the start time and duration for each office hour.

T1 = project_{classcode, starttime, duration} (select_{dayofweek <> Monday and dayofweek <> Wednesday} (Officehours))

T2 = project_{classcode} (select_{semester = fall and year = 2000} (Classes))

Result = T1 * T2

Question 2:

1.

(a) ABC

(b) $AC \rightarrow DE$ violates BCNF because AC is not a super key and this relationship is not trivial

(c) $AC \rightarrow DE$ violates 3NF because RHS is not a prime attribute

2.

(a) ABC, BCD

(b) $ABC \rightarrow DEF$. ABC is a super key. $AB \rightarrow A$ is trivial. $BCD \rightarrow AEF$. BCD is a super key.

Thus, it must be in BCNF

(c) Since it is in BCNF, then we can conclude that it is also in 3NF.

3.

(a) BC

(b) $ABC \rightarrow DE$. ABC is a super key. $BC \rightarrow AF$. BC is a super key.

Thus, it must be in BCNF

(c) Since it is in BCNF, then we can conclude that it is also in 3NF.

4.

(a) ABC, BCD

(b) $BD \rightarrow A$. BD is not a super key, thus it violates BCNF

(c) $BD \rightarrow A$. A is a prime attribute. Thus, it satisfies 3NF but not BCNF.