An-Najah National University – Department of Civil Engineering

Transportation Systems III 1st Midterm Exam

October 14, 2009 1Hr : 15 min

Dr. Khaled Al-Sahili Dr. Sami Hijjawi

## Part I – Closed Book – 20 minutes only – (5 points)

**Q1. (15 points) Choose the most appropriate answer for the following questions:**

1. **According to Unified Soil Classification, soil having the symbol CL refers to:**
   1. Clayey sand of low plasticity c) Inorganic Clay of low to medium plasticity
   2. Organic clay with low plasticity d) Non of the above
2. **According to AASHTO Soil Classification, soil having the classification of A-4 is:**
   1. Granular material and is good as a subgrade
   2. Clayey material and is good as a subgrade
   3. Clayey soil and is poor as a subgrade
   4. Silty soil and is fair to poor as a subgrade
3. **One of the following is a measure of field compaction using destructive testing:**
   1. Nuclear density gauge c) Sand cone method
   2. Oil replacement method d) Balloon
4. **The general objective of the CBR test is to:**
5. determine the relative strength of a soil with respect to an excellent coarse base material
6. determine the optimum moisture content and maximum density of a soil
7. Determine the stability value of a soil, N
8. Determine the compressive strength of a soil
9. **A base course of 65 CBR value is considered:**
   1. Poor quality c) may be accepted
   2. Good quality d) within acceptable limits
10. **Slow-curing cut-back asphalt has a grade of SC-70. The number 70 refers to:**
    1. Approximate kinetic viscosity in Centi-Stokes
    2. Approximate kinetic viscosity in seconds
    3. Approximate furol viscosity in Centi-Stokes
    4. Approximate furol viscosity in seconds
11. **The ability of asphalt material to resist weathering is described as the** 
    1. Stability c) Aging
    2. Durability d) consistency
12. **Values shown on the y-axis represents:**

|  |  |
| --- | --- |
| * 1. Percent of air voids.   2. Flow   3. VMA   4. Unit weight | **Y**  **% AC by weight of mix** |

1. **In Marshall aggregate mixes, fine aggregates is that part of aggregates that:**
   1. Passes through sieve #40 c) Passes through sieve #200
   2. Passes through #10 and retains on #200 d) retains of #40 and passes #200
2. **Effective asphalt content is:**
   1. The total asphalt content in the asphaltic concrete
   2. The asphalt absorbed into the aggregate particles
   3. The asphalt that coats outside the aggregate particles
   4. Only b + c
3. **The purpose of providing adequate voids in the total aggregate mix is to:**
   1. Allow water and air to circulate through the mix
   2. Allow aggregate to absorb limited amount of asphalt
   3. To ensure durable pavements
   4. Permit small amount of compaction when traffic load is applied

**Q2. (10 points) Answer whether the following 10 questions are true (T) or false (F):**

1. In general, as stability increases the unit weight of asphaltic mix increases.
2. High voids cause early aging of asphaltic pavement structure.
3. Consistency of asphalt in general is highly affected by its temperature.
4. The max. specific gravity of the paving mix assumes no voids in the asphalt concrete.
5. Effective asphalt content of asphalt mixes does not depend on the bitumen content.
6. Rapid curing cut-back asphalt is obtained by mixing asphalt cement with Gasoline or Naphtha
7. CBR is a type of penetration test used for subgrades, subbases, and basecourses.
8. Penetration test is a measure of consistency of bituminous materials expressed in millimeters.
9. The flash point is the temperature at which vapors will burn instantaneously in the presence of an open flame.
10. The mix design at optimum asphalt content should satisfy all the requirements of stability, flow, air voids, and VMA.

### **Q.3 (10 points) Provide a sketch for the following:**

1. Typical cross-section of pavement structure
2. The curve of Percent Voids in Mineral Aggregate (VMA) versus Asphalt Content by weight of mix
3. Proper results of CBR test (no correction is needed)

An-Najah National University – Department of Civil Engineering

Transportation Systems III - 61461 1st Midterm Exam

October 14, 2009 1Hr : 15 min

Dr. Khaled Al-Sahili Dr. Sami Hijjawi

## Part II – Open Book – 50 minutes only (65 points)

**Q-1 (20 points)** The following table shows data, which were summarized from tests on a saturated silty clay. On the basis of these data, compute:

1. liquidity index,
2. plasticity index
3. group index of soil.

c- Classify the soil according to AASHTO system

d-Describe the rating of the soil as subgrade.

|  |  |  |  |
| --- | --- | --- | --- |
| Water content (%) | 24 | Specific gravity | 2.73 |
| Liquid limit (%) | 48 | Shrinkage limit (%) | 12 |
| Plastic limit (%) | 22 | Passing sieve # 200 (%) | 92 |

**Q-2 (10 points)** Below are the results obtained from laboratory tests on two samples of medium curing asphalt cement:

|  |  |  |
| --- | --- | --- |
|  | Sample1 | Sample 2 |
| Kinematic viscosity at 60° C (mm2/s) | 45 | 72 |
| Flash point (° C) | 40 | 39 |
| Solubility in Trichloroethylene (%) | 99 | 100 |

Give the appropriate AASHTO designation for each sample.

|  |  |
| --- | --- |
| Sample 1 |  |
| Sample 2 |  |

**Q-3 (15 points)** The results of a CBR test for a soil sample are shown below. If the standard load for 0.1” penetration is 1700 psi and for 0.2” penetration is 2100 psi. Determine: (a) CBR value for this soil sample (b) Based on these test results, do you have any recommendations.



|  |  |
| --- | --- |
| **Penetration (in)** | **Load (psi)** |
| 0 | 0 |
| 0.025 | 11 |
| 0.05 | 20 |
| 0.075 | 31 |
| 0.1 | 50 |
| 0.125 | 73 |
| 0.15 | 96 |
| 0.175 | 127 |
| 0.2 | 142 |
| 0.225 | 150 |
| 0.25 | 154 |

**Q-4 (20 points)** Use the table and curves below with data about aggregates in an asphalt concrete mix and the Marshall test results to find out: (a) Optimum asphalt content by weight of total mix, (b) The asphalt absorbed at the optimum mix, (c) The maximum specific gravity of the mixture at AC=4.5%, and (d) the bulk specific gravity of the total mix at AC = 4.5%. The specified air voids range is 4 - 6%.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | |  | | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
| |  | | --- | |  | | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | |  | | |  |  |  |
|  | **Material** | | **Bulk SG** | **% by weight** | |  | | |
|  |  | | |
|  | AC | | 1.01 |  | |  | | |
|  | C.agg | | 2.60 | 42 | |  | | |
|  | F. agg | | 2.70 | 51 | |  | | |
|  | M. filler | | 2.69 | 7 | |  | | |
|  | Effective SG of agg. | | | 2.70 | |  | | |