

**ACTIVITY CODE: 1903105031**

**B. Sc. 6<sup>th</sup> Semester (Honours) Examination, October 2020**

**GEOLOGY**

**Course ID: 62022**

**Course Code: SHGEL-602C-14(P)**

**Course Title: Engineering Geology Lab**

**Time: 2 Hours**

**Full Marks: 15**

*The figures in the right hand side margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

Answer the following questions:

1. A hard metamorphic rock is slightly folded or faulted. The rock mass is moderately jointed, with joints striking perpendicular to the tunnel axis which is being driven east-west, and dipping at between 20° and 50°. Joints are of fair condition (slightly weathered and altered) and water inflow is moderate (200-1000 gallons per minute). Calculate the value of RSR.

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[Note that, the numerical value of Rock Structure Rating (RSR) is expressed by the formula:

$$RSR = A + B + C.$$

Where,

Parameter A, Geology: General appraisal of geological structure on the basis of:

- a. Rock type origin (igneous, metamorphic, sedimentary).
- b. Rock hardness (hard, medium, soft, decomposed).
- c. Geologic structure (massive, slightly faulted/folded, moderately faulted/folded, intensely faulted/folded).

Parameter B, Geometry: Effect of discontinuity pattern with respect to the direction of the tunnel drive on the basis of:

- a. Joint spacing.
- b. Joint orientation (strike and dip).
- c. Direction of tunnel drive.

Parameter C: Effect of groundwater inflow and joint condition on the basis of:

- a. Overall rock mass quality on the basis of A and B combined.
- b. Joint condition (good, fair, poor).]

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Table 1: Rock Structure Rating: Parameter A: General area geology

|             | Basic Rock Type |        |      |            | Geological Structure |           |            |             |
|-------------|-----------------|--------|------|------------|----------------------|-----------|------------|-------------|
|             | Hard            | Medium | Soft | Decomposed |                      |           |            |             |
| Igneous     | 1               | 2      | 3    | 4          |                      | Slightly  | Moderately | Intensively |
| Metamorphic | 1               | 2      | 3    | 4          |                      | Folded or | Folded or  | Folded or   |
| Sedimentary | 2               | 3      | 4    | 4          | Massive              | Faulted   | Faulted    | Faulted     |
| Type 1      |                 |        |      |            | 30                   | 22        | 15         | 9           |
| Type 2      |                 |        |      |            | 27                   | 20        | 13         | 8           |
| Type 3      |                 |        |      |            | 24                   | 18        | 12         | 7           |
| Type 4      |                 |        |      |            | 19                   | 15        | 10         | 6           |

Table 2: Rock Structure Rating: Parameter B: Joint pattern, direction of drive

| Average joint spacing           | Strike $\perp$ to Axis               |          |          |             |          | Strike $\parallel$ to Axis |         |          |
|---------------------------------|--------------------------------------|----------|----------|-------------|----------|----------------------------|---------|----------|
|                                 | Direction of Drive                   |          |          |             |          | Direction of Drive         |         |          |
|                                 | Both                                 | With Dip |          | Against Dip |          | Either direction           |         |          |
|                                 | Dip of Prominent Joints <sup>a</sup> |          |          |             |          | Dip of Prominent Joints    |         |          |
|                                 | Flat                                 | Dipping  | Vertical | Dipping     | Vertical | Flat                       | Dipping | Vertical |
| 1. Very closely jointed, < 2 in | 9                                    | 11       | 13       | 10          | 12       | 9                          | 9       | 7        |
| 2. Closely jointed, 2-6 in      | 13                                   | 16       | 19       | 15          | 17       | 14                         | 14      | 11       |
| 3. Moderately jointed, 6-12 in  | 23                                   | 24       | 28       | 19          | 22       | 23                         | 23      | 19       |
| 4. Moderate to blocky, 1-2 ft   | 30                                   | 32       | 36       | 25          | 28       | 30                         | 28      | 24       |
| 5. Blocky to massive, 2-4 ft    | 36                                   | 38       | 40       | 33          | 35       | 36                         | 24      | 28       |
| 6. Massive, > 4 ft              | 40                                   | 43       | 45       | 37          | 40       | 40                         | 38      | 34       |

Table 3: Rock Structure Rating: Parameter C: Groundwater, joint condition

| Anticipated water inflow<br>gpm/1000 ft of tunnel | Sum of Parameters A + B      |      |      |         |      |      |
|---|------------------------------|------|------|---------|------|------|
|   | 13 - 44                      |      |      | 45 - 75 |      |      |
|   | Joint Condition <sup>b</sup> |      |      |         |      |      |
|   | Good                         | Fair | Poor | Good    | Fair | Poor |
| None  | 22                           | 18   | 12   | 25      | 22   | 18   |
| Slight, < 200 gpm                                 | 19                           | 15   | 9    | 23      | 19   | 14   |
| Moderate, 200-1000 gpm                            | 15                           | 22   | 7    | 21      | 16   | 12   |
| Heavy, > 1000 gp                                  | 10                           | 8    | 6    | 18      | 14   | 10   |

<sup>a</sup> Dip: flat: 0-20°; dipping: 20-50°; and vertical: 50-90°

<sup>b</sup> Joint condition: good = tight or cemented; fair = slightly weathered or altered; poor = severely weathered, altered or open