

Mid-West University  
**Examinations Management Office**

End Semester Examinations-2080

Master level/ M. Sc. (Structural Engineering)/ 2<sup>nd</sup> Semester

Time: 3 hours

Subject: Rock Mechanics (ELE522/MSTR602)

Full Marks: 60

Pass Marks: 30

- Attempt all the questions.
- Figures in the margin indicate full marks.
- Assume suitable values, with a stipulation, if necessary.
- Candidates are required to answer the questions in their own words as far as possible.

1. What type of shallow foundation would you recommend for a building on heavily jointed and fractured rock site? Briefly discuss about the factors controlling the behavior of rock mass constituting discontinuities. Write about the design steps of rock foundation. Write about Goodman, Kulway and Carter equation for finding ultimate bearing capacity of rock? [10]
2. Define Rock mechanics with its applications in the field of infrastructure development. Differentiate between intact rock and rock mass. Define rock mass classification with its specific purpose. Write about Q system in rock mass classification. [10]
3. What are the factors affecting shear strength of rock? Discuss about Barton's formula to determine shear strength of jointed rock mass with its reliability. Present a critical analysis of Hoek Brown criterion of rock strength. Also discuss about scope and limitations of Hoek-Brown Failure Criterion. [10]
4. Which one is the most common failure in field? How do geological site conditions can affect the bearing capacity of rock foundation? Explain giving some field examples. Nepal is confronting with several geological hazards and slope failure problems from the very past. What can be the major factors accelerating for such failures. As a structural engineer suggest the ways of treatment of such failures encompassing rock fall and avalanches? [10]
5. A small cavern will be excavated in a mass of norite with UCS of 160MPa. The overburden stress is expected to reach 10MPa at most and the ratio of the horizontal principal stress to vertical principal stress is  $k=5/3$ . Other characteristics of rock mass are listed below.
  - a) The RQD is 80%
  - b) The rock mass contains one joint set controlling stability.
  - c) Joints are rough, irregular and undulating
  - d) There are unaltered joint walls with some surface staining
  - e) Stress conditions were deemed favorable to excavation.
  - f) There is medium hydraulic inflow with occasional outwash of joint fillings.What is the rating of this rock mass in the Q System? [10]
6. A Tunnel will be excavated in a sandstone rock mass (density is  $2.3 \text{ g/cm}^3$ ) at a depth of 80 m. At this depth sandstone has bedding planes with an orientation of 090/40, creating a set of joints which may be critical to the stability of tunnel. Joints in this set are highly weathered with slightly rough surfaces. The strength of intact rock is 85 MPa and values of RQD reported as 70%. The average joint frequency is 8 joints/m. The ground water existed at the tunnel depth with Ground water table 12 m below ground surface. The tunnel is being driven from west to east. Estimate the RMR value including rating adjustment for tunneling. Also present your critical review regarding construction of tunnel. [10]

**The End**