MIZORAM PUBLIC SERVICE COMMISSION

GENERAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF
JR. GRADE OF MIZORAM FOREST SERVICE (ASST. CONSERVATOR OF FORESTS)
UNDER ENVIRONMENT, FOREST & CLIMATE CHANGE DEPARTMENT,
GOVERNMENT OF MIZORAM, 2023

CIVIL ENGINEERING

Time Allowed : 3 hours | Full Marks : 100

The figures in the margin indicate full marks for the questions.
Answer any 10 (ten) questions taking 5 (five) questions from each section.

SECTION - A

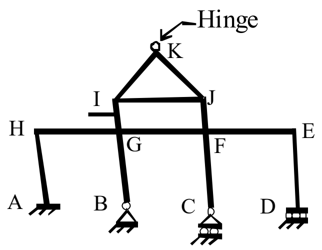
1. (a) What are the causes of various defects in timber as a construction material? **(5)**

(b) What are the Bogue's compounds in cement? Explain in very brief their role in hydration process of cement. **(5)**

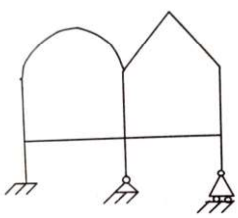
2. (a) For an isotropic material, derive the relationship between Youngs modulus (E), shear modulus (G), and Poisson ratio (μ). **(5)**

(b) If a small concrete cube is submerged deep in still water in such a way that the pressure exerted on all the faces of the cube is P. Calculate the maximum shear stress developed inside the cube. Also, justify your answer. **(5)**

3. (a) Determine the static indeterminacy of the structures shown below **(5)**



(b) Determine the kinematic indeterminacy of the structures shown below **(5)**



4. (a) What is a High strength friction grip (HSFG) bolt used in connections of steel structure? Differentiate between HSFG and bearing bolt with a neat sketch. **(5)**

(b) Explain how limit state method differs from working stress method for design of steel structures. **(5)**

5. The width and effective depth of a reinforced concrete beam is 250mm and 440mm, respectively. The beam is provided with 4 number of 20 mm tor bars in the tension zone. The beam is subjected to a shear force of 150 kN (Factored). Check the requirement of shear reinforcement and provide if necessary. Grade of concrete is M20 and that of steel is Fe415. The shear strength of concrete for different percentages of tensile steel are as below. 8 mm diameter vertical stirrups are available.

[V_{us}=0.87 $f_y A_{sv}$ d/S_v and (A/S_v)$\geq$ 0.4b/f_y with the terms having usual meaning] **(10)**

% of Steel	Shear strength of concrete (τ_c) in N/mm^2
1	0.62
1.25	0.67
1.5	0.72

6. A beam with rectangular cross section of size 250mm wide and 350mm deep is prestressed by a force of 400 kN using 8 numbers of 7 mm ϕ steel cables located at an eccentricity of 75 mm. Determine the loss of prestress due to creep of concrete. Grade of concrete is M40; Co-efficient of creep is 2; stress at transfer is 80%, Modulus of elasticity of steel(E_s) is 2.0 x 10^5 MPa. **(10)**

7. (a) What is the significance of Bar chart or Gantt chart in project management? **(2)**

(b) Draw the network for the project based on the following data of events. Find the Early start time, Early finish time, and determine the least number of days required to complete the work. Also draw the critical path. **(8)**

Event	Duration (Days)	Preceeders
A	2	-
B	4	-
C	1	A
D	6	B
E	7	C,D

SECTION - B

8. A pump can lift water at a discharge of 0.15 m^3/sec to a head of 25 m. The critical cavitation number (s_c) for the pump is 0.144. The pump is to be installed at a location where the barometric pressure is 9.8 m of water and the vapour pressure of water is 0.30 m of water. Intake by friction loss is 0.40 m. Using the minimum value of net positive suction head (NPSH), calculate the maximum allowable elevation above the sump water surface at which the pump can be located. **(10)**

9. A 6 hour unit hydrograph of a watershed is given below. Calculate 18 hour unit hydrograph using S-curve method and tabulate the result. **(10)**

Time (hr)	0	6	12	18	24	30
6 hour unit hydrograph (m3/cm)	0	1.8	30.9	85.6	41.8	14.6

10. A plain sedimentation tank of dimensions 20m length, 10m width, and 3m depth is used to treat 4 MLD of water. The average temperature of water is 20°C. The dynamic viscosity of water is 1.002×10^{-3} N.s/m^2 at 20°C. Density of water is 998.2 kg/m^3. Average specific gravity of particles is 2.65. Calculate the surface overflow rate in the sedimentation tank. Also calculate the minimum diameter of the particle which can be removed with 100% efficiency in the sedimentation tank. **(10)**

11. Two identical soil specimens were tested in a triaxial apparatus. The first specimen failed at a deviator stress of 770 kN/m^2 when the cell pressure was 200 kN/m^2. Second specimen failed at a deviator stress of 1370 kN/m^2 under a cell pressure of 400 kN/m^2. Determine the value of 'C' and 'f' analytically. Also, if the same soil is tested in a direct shear apparatus with a normal stress of 600 kN/m^2, estimate the shear stress at failure. **(10)**

12. Estimate the load carrying capacity of a single bored pile of 20m length, 500 mm diameter. The adhesion co-efficient(a) is 0.4. Consider a factor of safety of 2.5. The soil strata is as follows: **(10)**

Depth(m)	Soil deposit	Undrained shear strength (Su) kPa
0 - 5	Loose fill	50
5 - 10	Weather cover consolidated clay	70
10 - 15	Over consolidated clay	100
15 - 30	High over-consolidated clay	200

Assume $f_u = 0$ is valid and Nc = 9, for deep foundations.

13. Differentiate between the following : **(4×2.5=10)**

(a) Surveyors compass and Prismatic compass

(b) Declination and dip

(c) Fore bearing and back bearing

(d) Meridian and Bearing

14. The specific gravities and weight proportions for aggregates and bitumen are as under for the preparation of Marshall moulds:

	Weight (g)	Specific Gravity
Aggregate 1	825	2.63
Aggregate 2	1200	2.51
Aggregate 3	325	2.46
Aggregate 4	150	2.43
Bitumen	100	1.05

The volume and weight of one Marshall mould was found to be 475cc and 1100g. Assuming absorption of bitumen in aggregate is zero, find the following parameters:

(a) Percentage Air voids (V_v) **(5)**

(b) Percentage Bitumen by volume (V_b) **(5)**

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