

**M.E. CIVIL ENGINEERING FIRST YEAR SECOND SEMESTER  
EXAM 2025**

**DESIGN OF FOUNDATION UNDER DYNAMIC LOADING  
PART-I**

FM: 60 for this part (Total: 100)

[Assume any data reasonably wherever necessary]

1. (a) In connection with seismic design of gravity retaining walls using Richards-Elms Method, derive the following expression with a neat sketch:

$$F_W = F_T F_I$$

where,  $F_W$  = Weight factor

$F_T$  = Soil thrust factor

$F_I$  = Wall inertial factor

- (b) A 5m high retaining wall with backface inclined  $20^\circ$  with vertical retains dry cohesionless backfill ( $\phi = 30^\circ$ ,  $\gamma_t = 18.5 \text{ kN/m}^3$ , and  $\delta = 20^\circ$ ). The backfill surface is sloping at an angle  $15^\circ$  to the horizontal. Determine the weight of the retaining wall.

(i) For static condition.

(ii) For zero displacement condition under earthquake loading

(ii) For 50mm displacement under earthquake loading

[Take  $k_h = 0.15$ ,  $k_v = \pm 0.5k_h$ ]

**Given**

$$K_s = \frac{\cos^2(\phi - \beta)}{\cos^2 \beta \cos(\delta + \beta) \left[ 1 + \left\{ \frac{\sin(\delta + \phi) \sin(\phi - i)}{\cos(\delta + \beta) \cos(\beta - i)} \right\}^{1/2} \right]^2}$$

$$K_{AE} = \frac{\cos^2(\phi - \theta - \beta)}{\cos \theta \cos^2 \beta \cos(\delta + \beta + \theta) \left[ 1 + \sqrt{\frac{\sin(\phi + \delta) \sin(\phi - \theta - i)}{\cos(\delta + \beta + \theta) \cos(i - \beta)}} \right]^2}$$

where,

$\phi$  = soil friction angle,  
 $\beta$  = slope of the back of the wall with vertical,

$$\theta = \tan^{-1} \left( \frac{k_h}{1 - k_v} \right),$$

$\delta$  = angle of friction between the wall and soil

$i$  = backfill inclination angle

[10+20]

2. (a) In seismic slope stability analysis differentiate between inertial instability and weakening instability.

- (b) Referring to the Fig. 1 and using the method of slices, calculate the factor of safety of the slope for the following cases:

[ Turn over



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**SUBJECT: DESIGN OF FOUNDATION UNDER DYNAMIC LOADING**

**Time: 3 HOURS Full Marks: 40**

**PART II**

**Use Separate Answer scripts for each PART**

**Assume reasonable values of data not supplied**

1. Discuss with a neat sketch the methodology of the block vibration tests and how the coefficient of elastic uniform compression is determined from the test. 10
2. A concrete block foundation of size 8.0m x 4.0m x 2.0m is to be used as a foundation for a reciprocating engine operating at 450rpm and mounted symmetrically with respect to foundation. The weight of the engine is 10kN. Maximum unbalanced vertical force acting on the machine is 2.0 kN. Maximum unbalanced horizontal force = 3.0 kN. The magnitude of elastic uniform compression is,  $C_u = 5.0 \times 10^4 \text{ kN/m}^3$ . Take unit weight of concrete =  $24\text{kN/m}^3$ . Determine the natural frequencies and amplitude of the block by weightless spring approach. 20
3. Draw a neat sketch of foundation for Impact type machine. Write the equations of motion for hammer foundation considering Two-mass-spring analogy. Then derive the expressions for displacement for foundation and anvil. 10