

**ENGINEERING SERVICES  
EXAMINATION-2016**

Serial No.

**57823**

**A-HUF-P-EEA**

**CIVIL ENGINEERING**

**Paper—I**

**(Conventional)**

*Time Allowed : Three Hours*

*Maximum Marks : 200*

**INSTRUCTIONS**

*Please read each of the following instructions carefully before attempting questions :*

*There are **SEVEN** questions in the paper.*

*Candidates are required to attempt **FIVE** questions in all.*

*Question no. 1 is compulsory.*

*Out of the remaining **SIX** questions, attempt any **FOUR** questions.*

*The number of marks carried by a question / part is indicated against it.*

*Unless otherwise mentioned, symbols and notations have their usual standard meanings.*

*Assume suitable data, if necessary and indicate the same clearly.*

*Neat sketches are to be drawn to illustrate answers, wherever required.*

*All parts and sub-parts of a question are to be attempted together in the answer book.*

*Attempts of questions shall be counted in sequential order.*

*Unless struck off, attempt of a question shall be counted even if attempted partly.*

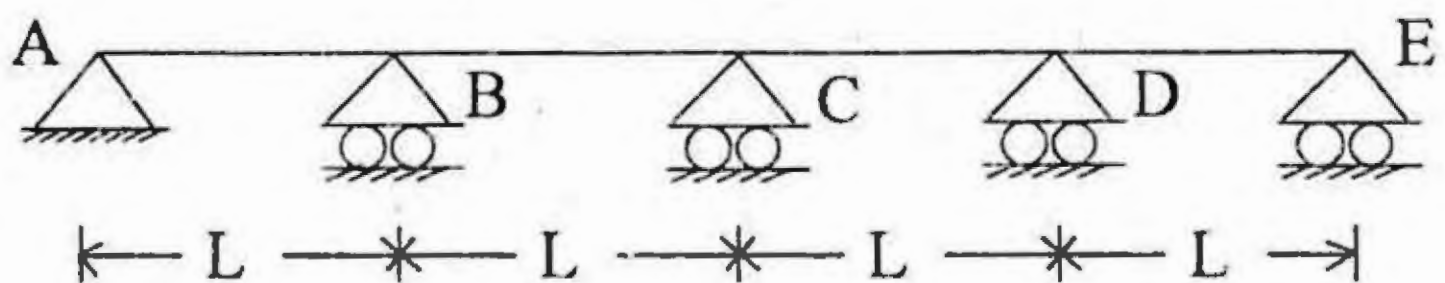
*Answers must be written in **ENGLISH** only.*

*Any page or portion of the page left blank in the answer book must be clearly struck off.*

1. Answer **all** of the following :  $8 \times 5 = 40$

(a) What do you understand by the term characteristic strength of a material ? Please elaborate. 8

(b) A continuous beam ABCDE is subjected to Dead Load and Live Load. Draw the arrangements of Live Load that produce maximum Bending moment at support B and span BC of the beam. 8

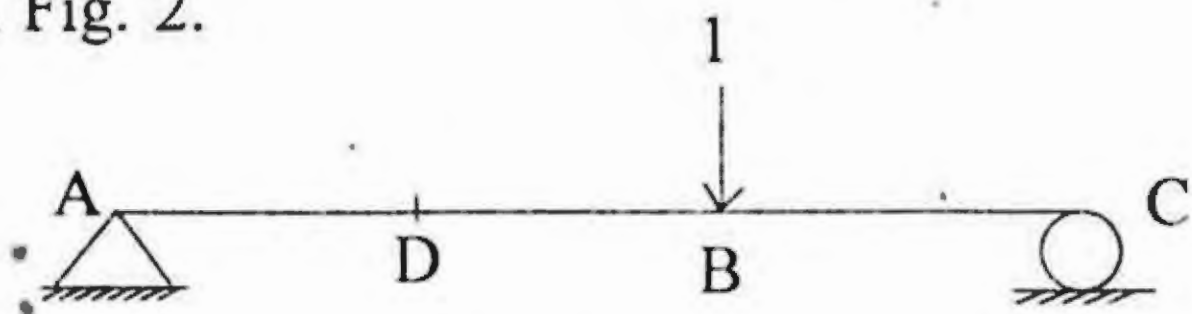


**Fig. 1**

(c) What do you understand by multiskilling of labour ?  
What are the benefits of multiskilling ? 8

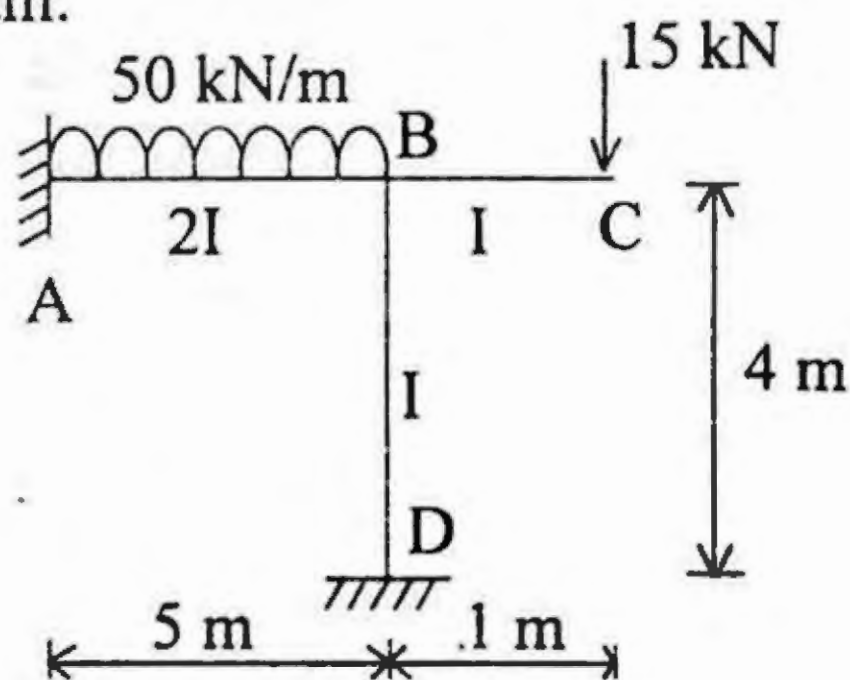
(d) What are the main advantages of Activity on the Node (A-O-N) networks over activity on the Arrow (A-O-A) networks ? 8

(e) State the Muller-Breslau principle. Hence draw influence line for moment at D in the beam shown in Fig. 2. 8



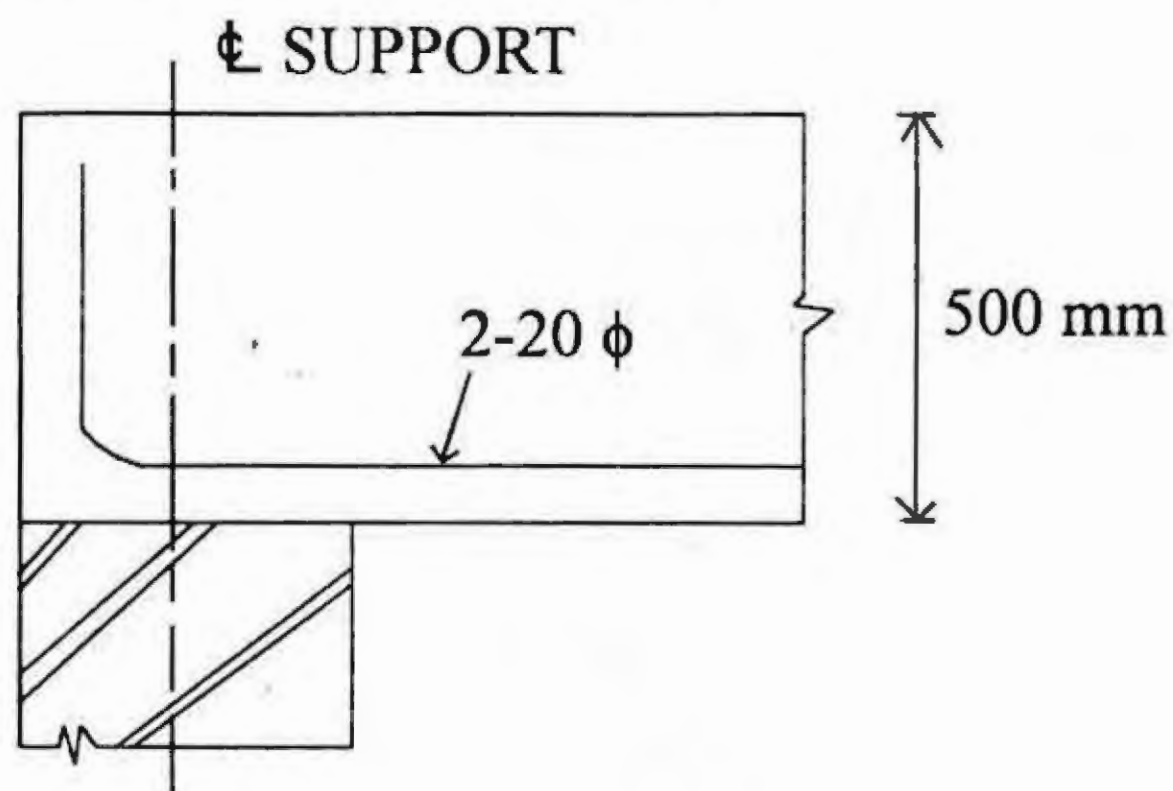
**Fig. 2**

2. (a) Explain with appropriate figures the failure criteria based on maximum shear stress theory. Also draw its Mohr circle representation. 15
- (b) A cylindrical shaft made of steel for which the tensile yield strength  $\sigma_y = 550$  MPa is subjected to static loads consisting of a bending moment of 700 kNmm and torsion of 400 kNmm. Determine the diameter of shaft for a factor of safety equal to 1.5 if  $E = 200$  GPa and Poisson's ratio  $\nu = 0.25$ ; Adopt maximum shear stress failure theory. 15
- (c) Draw a network for the following situations :
- (i) A is prerequisite on D
  - (ii) B is prerequisite on D and E
  - (iii) C is prerequisite on E
  - (iv) D is prerequisite on F
  - (v) E is prerequisite on F. 10
3. (a) Analyze the frame shown in Fig. 3 by the moment distribution method and draw bending moment diagram. 15



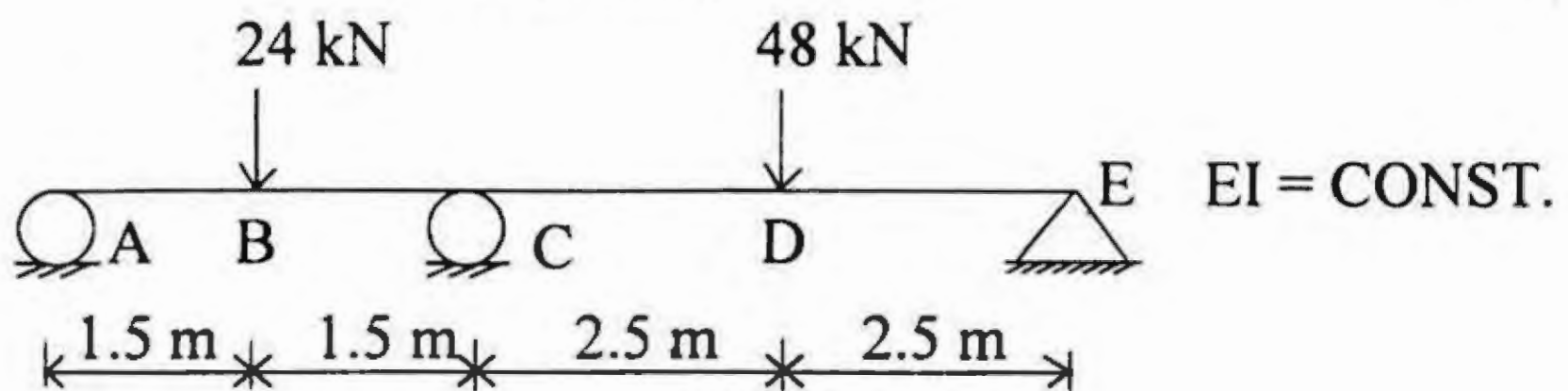
**Fig. 3**

- (b) A simply supported beam is  $25 \times 50$  cm deep and has 2-20 mm Fe 415 grade steel bars going into the support shown in Fig. 4. If the shear force at the center of support is 110 kN at service loads, determine the anchorage length. Assume M20 mix. Bond stress for mild steel for M20 concrete is 1.2 MPa in limit state. Take clear cover to steel = 25 mm. 20



**Fig. 4**

- (c) What do you understand by the term limit state ? 5
4. (a) Analyze a 2 span beam shown in Fig. 5 using the method of consistent deformations and draw shear force and bending moment diagrams. Treat reaction at A as redundant. 20



**Fig. 5**

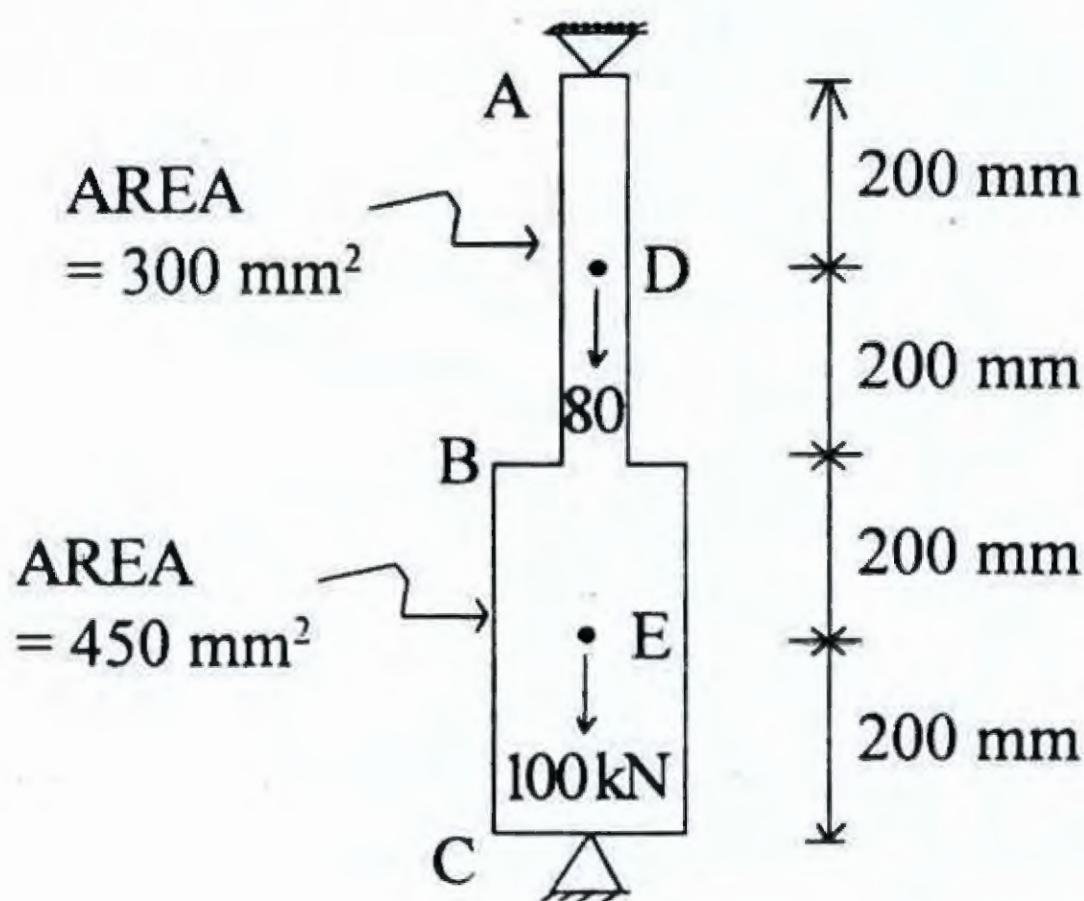
- (b) What is an admixture ? List four different mineral and chemical admixtures. 10
- (c) Elaborate the terms : Grade of timber, location and factor of safety with reference to structural timber. 10
5. (a) What are the assumptions for plastic analysis of steel sections ? 5
- (b) Show that in a rectangular section subjected to axial force  $N$  and bending moment  $M$ ,

$$\frac{M}{M_p} + \left( \frac{N}{N_p} \right)^2 = 1$$

where  $N_p$  = axial yield capacity

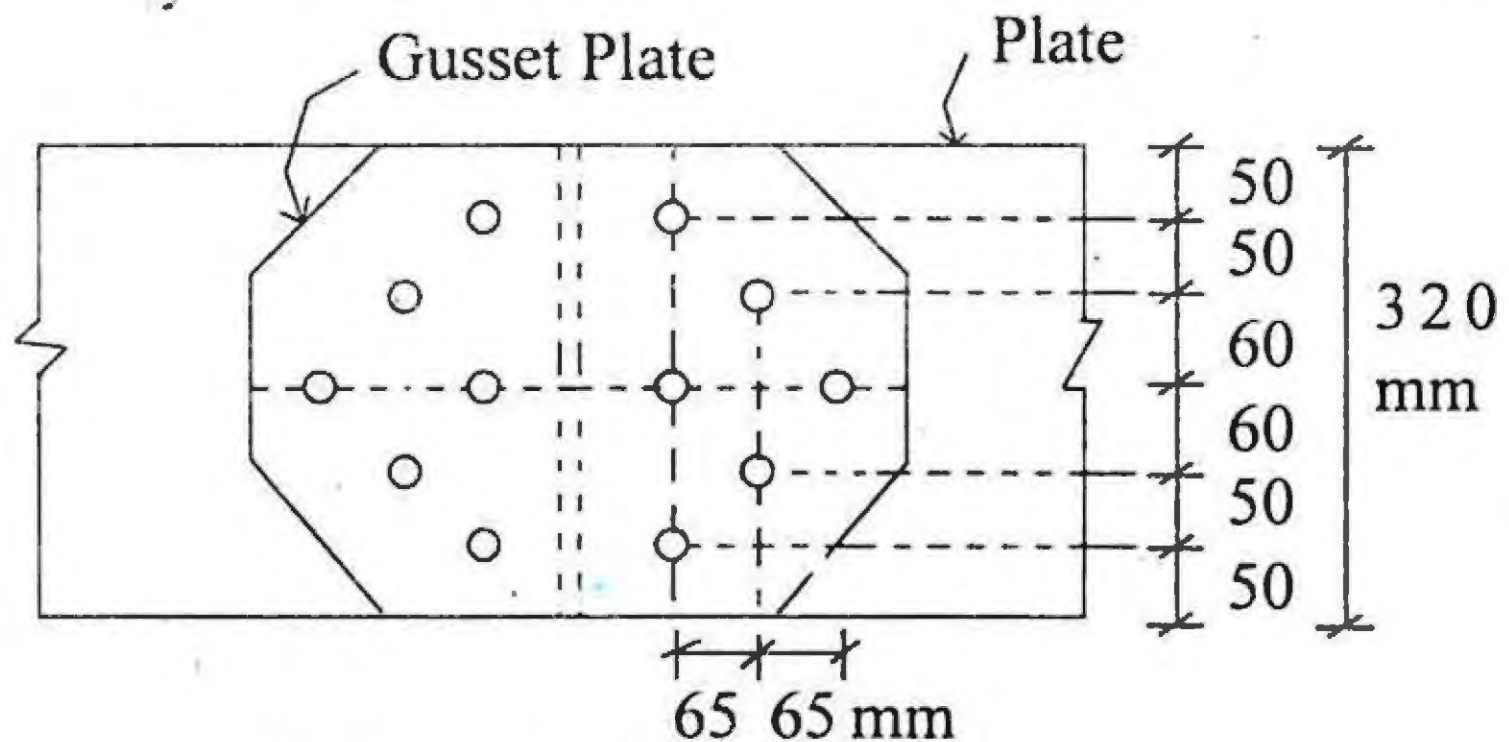
$M_p$  = plastic moment capacity. 10

- (c) A non-prismatic rod is attached between two supports as shown in Fig. 6. It is subjected to axial loads of 80 kN and 100 kN. Determine the support reactions and elongations. Take  $E = 200$  GPa.



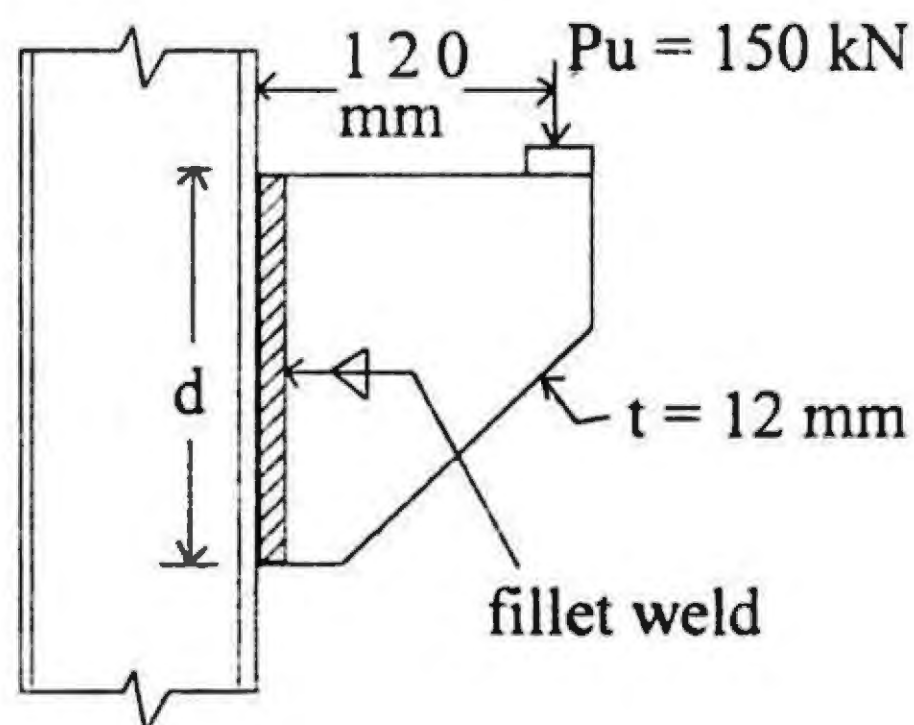
**Fig. 6**

6. (a) Two steel plates in axial tension are to be connected by bolts as shown in Fig. 7. Determine its tensile strength. Bolt dia = 25 mm, Hole dia = 28 mm, Plate thickness = 16 mm each,  $f_u = 440$  MPa,  $f_y = 290$  MPa. 20



**Fig. 7**

- (b) A welded bracket connection is shown in Fig. 8. It supports a factored load of 150 kN at a distance of 120 mm from the face of the column. Design the fillet weld on two sides. Grade of steel = Fe 410,  $f_y = 250$  MPa. 10



**Fig. 8**

- (c) Show various components of a steel plate girder through neat sketches. Explain design criteria of each and the corresponding limit state. 10

7. (a) In a CPM network, the critical path includes five activities. Their durations are tabulated as follows :

| Duration (Days) |                           |                            |                            |
|-----------------|---------------------------|----------------------------|----------------------------|
| Activity        | Optimistic Time ( $T_o$ ) | Most Likely Time ( $T_m$ ) | Pessimistic Time ( $T_p$ ) |
| A               | 2                         | 4                          | 7                          |
| B               | 5                         | 8                          | 14                         |
| C               | 4                         | 6                          | 8                          |
| D               | 2                         | 2                          | 2                          |
| E               | 7                         | 10                         | 21                         |

Compute the following values :

- The probability that the project will finish by the end of day 32
- The probability that the project will finish by the end of day 34
- The probability that the project will finish before day 30
- The probability that the project will finish on the 32<sup>nd</sup> day

- (v) The probability that the project will finish no later than the 35<sup>th</sup> day

|             |     |        |       |       |
|-------------|-----|--------|-------|-------|
| Z =         | 0   | 0.34   | 0.67  | 1.01  |
| Probability | 50% | 63.33% | 74.9% | 84.4% |

20

- (b) List the factors that influence the basic permissible compressive stresses for masonry for different mortars. Also elaborate the modification due to each factor. 10
- (c) A two hinged symmetrical parabolic arch of span 30 m and central rise 6 m carries a point load of 40 kN at a distance of 5 m from the left support. Find the horizontal thrust at each support. Also find the maximum bending moment. 10