TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Use design codes IS456, IS1893, IS13920 are allowed.***
- ✓ ***SP16 is allowed for column design only.***
- ✓ *Assume suitable data if necessary.*

1. a) Describe about the requirement of steel as reinforcement in RCC structure. Explain about moment of resistance of doubly reinforced section. Derive the formula. [2+2+4]

   b) Calculate the tensile reinforcement required for a rectangular RC beam of size 230mm×425mm (overall) if it has to carry a moment of 64KNm at service condition. Use M20 grade concrete mix and Fe500 grade steel in working stress method. [8]

2. a) Describe the method of controlling deflection and cracking in RCC structure. [2+2]

   b) Determine the longitudinal and transverse reinforcement of RC column subjected to a factored axial load of 1440KN and factored moment Mux about major axis of 195 KNm and Muy about minor axis 180KNm. The size of column is 350mm × 350mm and unsupported length of 3.60m.Adopt M20 concrete and Fe500 grade (TMT) steel. Also do the ductile detailing of transversal reinforcement. [12]

3. a) Define development length and ductility. Describe the ductility requirements in different joints of RCC structure. [1+1+4]

   b) A RC beam has an effective depth of 550mm and a breadth of 300mm. It contains 4 no. of 20mm dia bars out of which two bars are to be bent up at 45° near end of the support. Calculate the shear resistance of bent up bars and the additional stirrups needed if the factored shear force due to uniformly distributed load is 425KN at the support. The span of the beam is 6m. Use M20 grade concrete mix and Fe415 grade (TOR) steel. [10]

4. a) Define balanced, under-reinforced and over-reinforced sections. [3]

   b) Design a RCC footing to carry a column load of 1250KN from 400×400mm square column having 20mm diameter bar as longitudinal steel. The bearing capacity of soil is 140KN/m^2. Consider the depth of foundation as 1.8m. Take unit weight of earth as 18KN/m^3. Use M20 grade concrete mix and Fe415 grade steel. Also sketch the reinforcements in plan and section. [13]

5. a) What is splicing and why it is required in RCC structures. [2]

   b) Design a RC slab over a room 5m×6m. The slab is supported on masonry walls all round with adequate restraint and corners are held down. The live load on slab is 3KN/m^2 and floor finish 1.5KN/m^2. The thickness of supporting wall is 230mm. Use M20 concrete mix and Fe415 grade steel. Also draw the tp and bottom reinforcement detailing with their section and plan. Check for deflection and development length is necessary. [14]

***

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE 702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Use design codes IS 456, IS 1893, IS 13920 are allowed and SP16 is allowed to column design only.***
- ✓ *Assume suitable data if necessary.*

1. a) Explain with the help of sketches, under-reinforced, over-reinforced and balanced sections. [4]

   b) What are the serviceability requirements in the limit state design of RC structures? Explain them briefly. [4]

   c) A rectangular RC beam of overall dimensions 250mm × 450mm is reinforced with 4-16 mm dia. bars in tension at an effective cover of 40mm. Calculate the moment of resistance of the beam using working stress method. Adopt M20 concrete and Fe415 grade steel. [8]

2. a) A reinforced concrete rectangular beam has an overall depth of 500mm and breadth of 300 mm. It consists of 5-25 mm dia bars in tension and 3-16 mm dia. bars in compression. Calculate the shear reinforcement needed for a factored shear force of 370 kN. Take M20 grade concrete and Fe415 grade (TOR) steel. Also check the spacing for minimum shear reinforcement. [8]

   b) A rectangular RC beam of overall dimensions 650 mm by 300 mm is subjected to a factored bending moment of 85 kN-m, factored shear force of 110 kN and factored twisting moment of 25 kN-m. Design the beam for longitudinal and transverse reinforcements. Use M25 grade concrete and Fe415 grade steel. [8]

3. a) Design a short rectangular column of size 350mm × 500mm and unsupported length of 3.30m subjected to an axial factored load of 1500 kN and factored moments 130 kN-m and 80 kN-m about major and minor axes respectively. Adopt M30 grade concrete and Fe500 grade steel. Sketch the reinforcement details. [14]

   b) Define development length and lap splice. [2]

4. Design a RCC slab for a room of clear dimensions 6m × 4m whose one short edge is discontinuous and corners are restrained at supports. The live load on the slab is 4 kN/m^2 and superimposed load of 1.20 kN/m^2. Adopt M20 grade concrete and Fe415 grade steel. Check the slab for deflection, and development length. Give the detail sketches, sectional view along short span with reinforcement details along with torsional reinforcements. [16]

5. a) Design a R.C.C isolated footing to carry an axial load of 1500 kN. The column is 350mm ×350mm in size with 20mm diameter, 8 Nos longitudinal bars. The bearing capacity of soil is 175 kN/m^2. Use M20 grade concrete and Fe415 grade steel. Assume missing datas. [10]

   b) Explain with the help of sketches the ductile detailing of RC beams. [6]

***

02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Use of IS:456-2000, IS:1893, IS:13920 are allowed.*
- ✓ *Students are not allowed to use SP16 except for the column design.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain under-reinforced, balanced and over-reinforced sections in Limit state design. [6]

   b) A simply supported rectangular RC beam of effective span 4.2 m and overall dimensions 230 mm × 450 mm is reinforced with 4-20 mm dia. bars in tension. Determine the moment of resistance. Take permissible stresses for M20 concrete and Fe415 grade steel. [6]

   c) A rectangular RC beam of size 250 mm × 500 mm (effective depth) is subjected to a factored shear force of 110 KN. The beam is reinforced with 3-22 mm dia. bars in tension. Design the shear reinforcement. Consider M20 concrete and Fe500 steel. [8]

2. a) Design a slab panel having one short edge discontinuous for a room size of 4 m × 5 m. The edges of slab is supported on walls of width 250 mm. The slab is carrying a live load of 4 KN/m^2 and floor finish of 0.75 KN/m^2. Use M20 Concrete and Fe415 steel. Sketch the reinforcement detailing in plan and sections. Check for deflection and development length are necessary. [15]

   b) What is anchorage bond? Derive the expression $L_d \leq 1.3\frac{M_1}{V} + L_o$, with usual notations. [1+4]

3. a) Explain the limit state of serviceability and its requirements in RCC structure. Also list the different types of splicing of reinforcements in RC structure. [4+1]

   b) A RC column of size 35 cm × 40 cm with unsupported length of 3.10 m is subjected to a factored axial load of 1500 KN and biaxial moments, M_{ux} = 125 KNm and M_{uy} = 88 KNm. The ends of the column are effectively held in position but not restrained against rotation. Design the column for longitudinal and transverse reinforcements, and sketch the details. Use M25 Concrete and Fe500 grade steel. [15]

4. a) Design a footing for a square column of size 350 mm × 350 mm reinforced with 8-16 mm dia. bars. The column is subjected to a factored axial load and moment of 1100 KN and 60 KN-m, respectively. The allowable bearing capacity of soil is 150 KN/m^2 at a depth of 1.5 m. Use M20 Concrete and Fe 500 steel for footing, and M30 Concrete and Fe 500 steel for column. Assume that the moment is reversible. Sketch the details (Plan and sections). [14]

   b) Draw the typical reinforcement drawing for a flight and a landing of RCC staircase. Also define the effective span for staircase. [5+1]

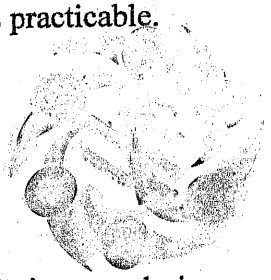
***

02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Use of IS:456-2000, IS:1893, IS:13920 are allowed.*
- ✓ *Students are not allowed to use SP16 except for the column design.*
- ✓ *Assume suitable data if necessary.*



1. a) Distinguish the differences between the working stress method and limit states design. What is modular ratio? Why should it be considered in the design? [4+1+1]

   b) A RCC T-beam of 1650 mm width of flange, 120 mm depth of flange, 250 mm width of web, and 525 mm effective depth has to carry a factored bending moment of 760 KN-m. Determine the reinforcements required. Use M20 concrete and Fe 500 steel. [14]

2. a) What is flexural bond? Derive expressions for flexural bond stress. Why do the cover and spacing of bars affects the bond strength? [1+4+1]

   b) Design a slab pannel for a room size of 6.3m × 4.5m. The slab is supported on beams with two adjacent edges discontinuous. The super imposed load on the slab is 5 KN/m^2. The materials used are M25 concrete and Fe 500 steel. Check for deflection and cracking control are necessary. Also sketch all reinforcement detailing (Plan and sections). [14]

3. a) What is ductility? Why should it be considered in the design? List the various precautions to be undertaken in the case of R.C.C. columns subjected to earthquake loads. [1+2+2]

   b) Design a column with unsupported length of 3.25m and subjected to biaxial bending for the following data: Effective lengths L_{ex} = 3m and L_{ey} = 2.75m, size of column = 400mm × 600mm, factored axial load (P_u) = 2250KN, and factored moments, M_{ux} = 256KN-m, M_{uy} = 160Kn-m. Assume M30 concrete, Fe500 steel, and moderate exposure. Also, sketch the reinforcement detailing with appropriate transverse reinforcement. [15]

4. a) A rectangular beam of width 250mm and effective depth 450 mm is reinforced with 4-22 mm dia. bars at mid-span of which two bars are bent at the ends at 45°. The beam is provided with shear reinforcement of two-legged 10mm diameter vertical stirrups throughout the beam at a spacing of 220 mm c/c. calculate the shear resistance of the beam. Adopt M25 concrete and Fe 415 steel. [6]

   b) Design a footing to support a 300 mm × 400 mm column. The column carries a factored axial load of 1400 KN and a factored moment of 90KN-m. The allowable soil pressure is 200 KN/m^2 at 1.5m depth. Use M20 concrete and Fe415 steel for footing; and M25 concrete and Fe415 steel for column. Assume that the column is reinforced with 6-22 mm dia bars. Unit weight of soil above footing base = 20 KN/m^3. Note that the moment is reversible sketch the detail. [14]

***

01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Use of IS 456, IS 13920 are allowed. IS 456 SP-16 is allowed to design column only.*
- ✓ *Assume suitable data if necessary.*

1. a) A rectangular R.C beam of size 230×350 mm overall is reinforced with 4-16 mm dia bars at tension zone in bottom, determine the moment of resistance of that beam section if the permissible stresses in concrete and steel does not to exceed 7.0 Mpa and 140 Mpa respectively. Take Nominal cover to re-bar as 25 mm and m =13.33. [7]

   b) Define anchorage bond and flexural bond stress. Prove that flexure bond stress is the function of shear force (V) and $L_d \leq 1.3\frac{M_1}{V_u} + L_0$ at supply support end, where symbol have their usual meaning. [7]

   c) With the help of neat sketch, describe the requirement for confining reinforcements in RC columns for earthquake resistant design. [6]

2. a) A Reinforced concrete beam has an effective depth of 600 mm and a breadth of 400 mm. It contains 5 no of 25 mm dia bars out of which two bars are to be bent up at 45° near end of the support. Calculate shear resistance of bent up bars and additional stirrups needed if the factored shear force diagram is 250 kN at support and 0 kN at mid span of 6 m span beam. Use M20 grade steel and Fe 415 steel. [14]

   b) Describe the step-by-step procedure used for the design of RC bean subjected to shear moment and torsion. [6]

3. a) A rectangular slab panel 5 m × 4 m (clear span) is continuous over three edges and discontinuous over one short edge. The slab carries a floor finish of 1.20 KN/m^2 and live load of 4.0 KN/m^2. Design the slab panel with detailing the top and bottom reinforcements. Sketches the re-bar details clearly. The width of slab supported beam as 225 mm. Take M20 concrete and Fe 415 steel. [14]

   b) Explain different category of limit state design with necessary details. [6]

4. a) Determine the longitudinal and transverse reinforcement in bi-axialy loaded column having a following parameters: [15]

   Unsupported length of column = 3.10 m

   Size of column = 500 mm×600 mm

   Factored moment, Mux = 125 kN.m;

   Factored load, p_u = 1300 KN

   Factored moment, M_{uy} = 200 KN.m

   Use M25 concrete and Fe 500 steel. Take reinforcement in four side. Sketch the details.

   b) Describe the design procedure for mat foundation. [5]

***

01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Use of IS 456, IS 13920 are allowed. IS 456 SP-16 is allowed to design column only.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain how would you design shear reinforcements for flanged beam sections. [5]

   b) A beam of rectangular section is 300mm wide and 500mm deep to the centre of tensile reinforcement. It has to carry a dead load of 45 kN/m excluding its self weight. Find the steel reinforcement required for the mid span section. The beam has a span of 7m. Use M20 concrete and Fe 415 steel. Effective cover to compression steel = 40 mm. Use limit state method. [15]

2. a) Explain briefly ductile detailing requirements for beam and column with neat sketches. [6]

   b) Design a short RC column with following datas: [14]

   Unsupported length = 3.0 m

   Factored load, p_u = 1550 kN

   Factored moments: M_{ux} = 130 kN.m

   : M_{uy} = 90 kN.m

   Size of column = 300×450 mm

   Do ductile detailing for transverse steel.

3. a) Differentiate between working stress and limit state methods. [5]

   b) Design a restrained floor slab for a room 4m×5m in size to support a live load of 5 kN/m^2, with two adjacent sides discontinuous. Use M20 concrete and Fe415 grade steel. Sketch the details of reinforcements. [15]

4. a) Design an isolated footing to support a square column of 400×400 mm. The column (400×400mm) carries a service load of 1200 kN. The allowable soil pressure is 150 kN/m^2. Use M20 concrete and Fe415 grade steel. Unit weight of soil above footing base = 18 kN/m^3. Necessary missing data assume suitably. [10]

   b) A L-beam of effective and flange width as 925 mm, effective depth as 450 mm, depth of flange as 100 mm, breadth of rib as 250 mm is reinforced with 4-20 mm bars as tension reinforcement and 3-16 mm dia bars as compression reinforcement. Find the ultimate moment of resistance of the section at limit state of collapse. Use M20 grade concrete mix and Fe415 grade steel. [10]

***

02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

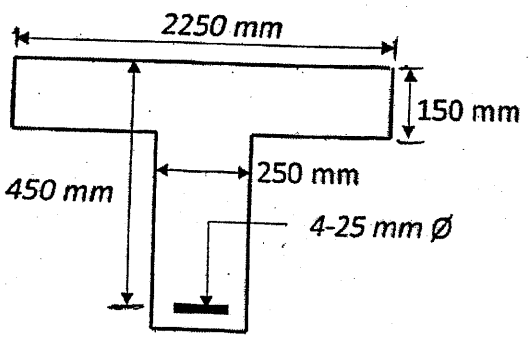
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Design codes IS 456, IS 1893, IS 13920 and SP 16 are allowed to use.*
- ✓ *Assume suitable data if necessary.*

1. a) Find the moment of resistance of a RCC beam 250 mm wide and 500 mm effective depth if it is reinforced with 3-16 mm dia bars. The permissible stresses for concrete and steel are given as 7 MPa and 230 MPa. The value of modular ratio is taken as 13.33. [6]

   b) Find the ultimate moment resisting capacity of a beam as shown in figure. Consider M 20 and Fe415 grade of concrete and steel. [14]



2. a) Design and detail an interior pannel of a slab resting on RCC beams on all sides for a room having clear dimensions of 4.5m*6.5m. The slab is subjected to a super-imposed live load of4KN/m^2 and floor finishes load of 2.5 KN/m^2. Take M20 concrete and Fe415 steel. [15]

   b) What is ductility? What are the significances of ductility in RC structures? [2+3]

3. a) Design the longitudinal reinforcements to be provided for a short column 400×500 mm subjected to following forces: [15]

   P_u = 1600 KN

   M_{ux} = 20.0 KN-m

   M_{uy} = 150 KN-m

   Use M25 concrete and Fe415 steel

   b) Discuss the methods of crack control as per IS456-2000 in RC structures. [5]

4. a) Design an isolated footing for a square column 450 mm× 450 mm, reinforcement with 8-20 dia bars and carrying a service load of 1600 KN. Assume bearing capacity of soil as 250 KN/m^2 and depth of foundation as 1.5 m. Adopt M20 concrete and Fe 500 steel. Also check the development length and bearing stress in concrete. [14]

   b) What do you understand by idealized stress-strain diagram of concrete and steel bar? Draw idealized stress-strain diagrams. Define characteristics strength of concrete and steel. [2+2+2]

***

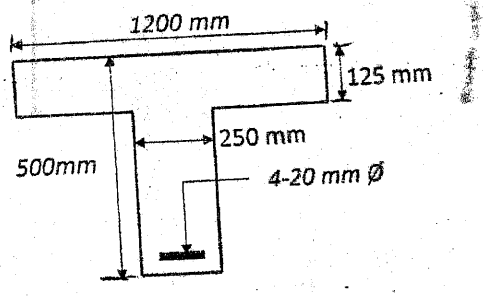
02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Design codes IS 456, IS 1893, IS 13920 and SP 16 are allowed to use.*
- ✓ *Assume suitable data if necessary.*

1. a) Find shear reinforcement required for a beam as shown in figure below. Beam is subjected to design SF of 250KN. Consider M25 and Fe500 grade of concrete and steel. [6]



b) A simply supported RCC beam of effective span 5.5 meter and overall dimensions 230mm×550mm is subjected to superimposed load of 50 KN/m excluding its self weight. Design the beam for limit state of collapse in flexure. Also check whether the beam is safe in deflection or not. Adopt mild exposure condition and use Fe 415 steel. Take effective cover to re-bars as 50 mm. [14]

2. a) A rectangular slab panel 5.5m×4.0m (clear span) is continuous over three edges and discontinuous over one short edge. The slab is to rest on 250mm wide beam. The slab is subjected to live load of 5KN/m^2 and floor finishes load of 1.0 KN/m^2. Design the slab. Sketch the arrangement of reinforcement bars at support and mid span separately with torsional re-bars. Check whether the section satisfies the deflection criteria. (Check for shear and development length not necessary) [15]

b) Why limit state method is better than working stress method. Explain in brief. [5]

3. a) Design the longitudinal and transverse reinforcements to be provided for a short column of size 35cm×45cm subjected to the following forces. [15]

Factored axial load P_u = 1800 KN
Factored moment M_{ux} = 175 KN-m
Factored moment M_{uy} = 105 KN-m
Reinforcements are distributed equally on two sides. Use M25 concrete and Fe500 steel. Unsupported length = 3.1 m

b) Define the term ductility in RC design. Draw a neat sketch of a beam-column joint including ductile details. [1+4]

4. a) Explain how a RC structural member subjected torsion, shear force and bending moment is designed. [6]

b) Design an isolated rectangular footing for a column of size 300mm×400mm. The column is reinforced 8-20 mm dia bars with M25 concrete. The column is carrying a factored axial load of 1200 KN and the factored moment of 120 KN-m. Sketch the details of designed reinforcements in plan and sections. Also check the bearing stress and development length required. Adopt M20 grade concrete for footing. Grade of steel used is Fe415. Assume bearing capacity of soil = 200 KN/m^2 at 1.25 below GL. [14]

***

02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ *Use of IS: 456-2000; IS 1893 and SP16 are allowed. But, use of SP 16 is allowed only for column design.*

1. a) State all the possible safety and requirements of limit state and define limit state of strength and serviceability. [4]

   b) Design a rectangle footing to carry a column load of 1150 kN and BM of 250 kN-m from 600×600 mm square column with the 20 mm diameter longitudinal steel. The bearing capacity of soil is 200 kN/m^2. Consider depth of foundation as 1.5 m. Take unit weight of earth is 17 kN/m^3. Use M20 concrete and Fe 415 steel. [16]

2. a) How do you consider earthquake loads while designing RCC structures? Explain briefly. [4]

   b) Design a slab for a room of size 3.6 m × 4.2 m prevented uplifting by walls (230 mm thick) loads for a intermediate storey of a residential building. Use M20 grade of concrete and Fe 415 grade of steel. Sketch the reinforcements. Carry out all necessary checks require in slab design. Take live load = 3kN/m^2, floor finish = 1 kN/m^2. [16]

3. a) Derive the formula $L_d \le \frac{M_1}{V} + L_0$, where the symbols have their usual meanings. [4]

   b) Determine the longitudinal and transverse reinforcements in a short rectangular column subjected to a factored axial load of 2000 kN and factored moment M_{ux} about major axis of 190 kN-m and M_{uy} about minor axis of 95 kN-m. The size of the column is 300 mm×500mm and the unsupported length of 3 m. Adopt M30 concrete and Fe 500 grade steel. [16]

4. a) Explain with the help of sketches the requirements on reinforcement detailing in beams to ensure sufficient ductility. [6]

   b) A L-beam has a flange of effective width 900 mm and depth of 100 mm. The web below is 250 mm×500 mm. Determine the amount of reinforcement required for the cross-section if it has to carry a factored bending moment of 615 kN-m and SF of 50 kN. Adopt M20 concrete mix and Fe 500 grade steel. [14]

***

02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ *Use of IS: 456-2000; IS 1893 and SP16 are allowed. But, use of SP 16 is allowed only for column design.*

1. a) Using working stress method, design a rectangular section 300 mm width and 450 mm height carrying 30KN/m load in the effective span 3.6m. Use mild steel and M20 grade of concrete. [4]
   b) Enlist and make sketch of three kind of mechanical splices. [2]
   c) Design a short rectangular column of size 450mm×300mm and unsupported length 3 m subjected to an axial ultimate load of 1500KN and ultimate moments 150KNm and 80KNm a long major and minor axes respectively. Adopt M30 grade of concrete and Fe500 grade of steel. Sketch the final design. [14]
2. a) Write down the steps of design of a beam subjected to BM, SF and Torsion. [4]
   b) Design slab of a room of size 6.5m×4m for a live load of 4.5 KN/m^2 and floor finish of 1 KN/m^2 of slab are rigidly fixed with beam. Take width of beam 230 mm. Use M20 concrete and TMT bars. Draw top and bottom reinforcement detailing with sections. Carry out all checks required for slab design. [16]
3. a) Write provisions of ductile detailing of column with neat sketches. [6]
   b) Design an isolated footing to carry a column load of 1300 KN and BM of 100 KN-m from both axes of column. Column is 500 mm×500mm in size with 25 mm diameter longitudinal steel. The bearing capacity of soil is 220 KN/m^2. Consider depth of foundation as 1.70 m. Take unit weight of soil as 18.5 KN/m^3. Use M25 grade concrete and Fe415 steel. [14]
4. a) Discuss in detail the working stress method versus limit state method of design with their respective advantages and disadvantages. Compare balance, under reinforcement and over reinforced sections in limit state and working stress design methods. [8]
   b) A RC beam 300 mm× 500 mm is reinforced with 5-25 mm bars in tension and 5-12 mm bars in compression each at a clear cover of 25 mm. If effective span of the beam is 4.30 m. find the moment of resistance of the beam at ultimate state. Use M25 concrete and Fe 415 grade steel. [12]

***

02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ IS 456-2000, IS 1893-2002, IS 13920-1994 and SP16 are allowed to use.
- ✓ *Assume suitable data if necessary.*

1. a) Design the longitudinal and shear reinforcements required for a rectangular beam with simply supported effective span of 4.75 m. The beam is carrying 10 KN/m from 125 mm thick slab and live load of 5 KN/m; floor finish of 3.5 KN/m and partition wall 10 KN/m. The size of beam is restricted to 250 × 400 mm. Assume mild exposure condition as per IS 456 and steel as Fe 415. [15]

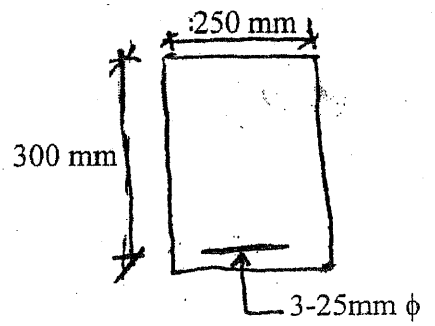
   b) What is the principle of earthquake resistant design? Write ductility requirements of RC column. [5]

2. a) Determine the longitudinal and transverse reinforcements of RC column for the following data: [14]
   Size of column = 500 mm × 500 mm
   Factored load, P_u = 1000 kN
   Factored moment M_u = 150 kN-m
   Unsupported length = 6 m with both ends fixed and effectively held position
   M20 concrete and Fe 415 steel

   b) Show that $L_d = \dfrac{0.87 f_y \phi}{4\tau_{bd}}$ and $L_d = 1.3\dfrac{Ml}{V_u} + ld$ where symbols have their usual meanings. [6]

3. a) Design a floor slab for a room 5.4 m× 6.6 m clear in size to support a superimposed service load of 5 KN/m^2. Two adjacent edges of slab are continues. The support width of slab on all four sides is 300 mm. Also check whether the slab is safe in deflection or not. Draw neat sketches of slab showing top and bottom arrangements of reinforcements with section of slab along short span. (Design for shear and bond is not necessary) [14]

   b) Using working stress method, determine the moment of resistance of the section of beam as shown in figure below. Take σ_{cbc} = 7 N/mm^2 and σ_{st} = 140 N/mm^2. [6]



4. a) An isolated reinforced concrete footing has to transfer a service load of 800 KN from a square column of 300 × 300 mm. Consider concrete grade M20, Torsteel and soil bearing capacity 180 KN/m^2. Design the isolated footing and draw neat sketch of footing showing all reinforcements. [12]

   b) Describe the design of beam subjected to bending moment shear force and torsion. [8]

***

02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of RCC Structure *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ IS 456-2000, IS 1893-2002, IS 13920-1994 and SP16 are allowed to use.
- ✓ *Assume suitable data if necessary.*

1. a) Is the limit state method better method of design of concrete structures than the working stress design method? Give reasons for your answer. [6]

   b) Explain the terms "balanced", "over reinforced" and "under-reinforced" sections in bending in Limit state method with corresponding strain and stress in concrete and steel. [6]

   c) A RC beam has an effective depth of 450 mm and a breadth of 250 mm. It contains 4-20 mm dia. TOR steel bars, out of which two bars are to be bent up at 30° near the support. Calculate the shear resistance of the bent up bars. Use M20 mix. What additional stirrups are needed, if it has to resist a design shear force of 125 kN. [8]

2. a) What is the characteristic strength of material and characteristic load? How design strength of material and design load are calculated. [5]

   b) Design an internal panel of reinforced concrete slab for room having clear dimensions of 3m×4m. The slab rest on 230 mm wide beam. Consider 15 mm thick PCC floor finish and live load of 4kN/m^2 on slab. Use M20 concrete and Fe 415 grade steel. Check slab in shear and deflection also. Show top and bottom arrangement of reinforcement. [15]

3. a) Design a RC column with the following data: [14]
   Size of column = 300 mm ×450 mm
   Axial load = 1200 kN
   M_{ux} = 200 kN-m
   M_{uy} = 300 kN-m; l =5m; $l_{ex} = l_{ey}$=3.5m
   Take M25 concrete and TMT bars.

   b) Specify methods of controlling deflection and crack with in RC structures. Explain emperical method of controlling deflection. [6]

4. a) What are the factors affecting the ductility. Explain the ductility requirement of R.C.C beam as per IS 13923. [6]

   b) A column of section 400 mm×400 mm is subjected to an axial load of 800 kN and uniaxial moment of 300 kNm at service state. Design a reinforced concrete footing for this column using M20 grade concrete and Fe 415 steel. Take allowable bearing capacity of soil = 100 kN/m^2. [14]

***

06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of Reinforced Structures *(CE702)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ *IS 456 is allowed to use. SP-16 is allowed only for design of column.*

1. a) Differentiate working stress and limit state design methods. [5]

   b) Design a simply supported rectangular beam with the span 6 m for bending and shear. The beam carries live load of 8 kN/m. Use M20 concrete and Fe 415 steel. [15]

2. a) Write the basic assumptions of limit state of collapse in flexure. Derive formula of moment of resistance for balanced section of beam. [5]

   b) Design a simply supported slab not having adequate provision to resist torsion at corners and to prevent the corners from fitting. The factored live load is 4 kN/m^2 and the load of the floor finish in 0.5 kN/m^2. The effective spans are 6 m and 4.5 m. Use M 20 and Fe 415. The width of the support is 300 mm. Show neat sketches of reinforcement detailing. [15]

3. a) What is detailing of reinforcement? Derive the formula of development length of reinforcing bar? [5]

   b) Design an isolated footing for a rectangular column, 400 mm × 600 mm with 8-25 mm diameter longitudinal bars carrying a service load of 3500 kN. Assume safe bearing capacity of soil as 175 kN/m^2 at a depth of 1.8 m below ground level. Use M 20 and Fe 415 grade of concrete and steel. [15]

4. a) Explain types of shear failure in beam. [5]

   b) Design biaxialy loaded column for the following data: [15]

      i) Size of column 400 mm ×600 mm
      ii) Factored moment Mux = 200 kNm
      iii) M 20 concrete and Fe 415 steel
      iv) Factored load, Pu = 1500 kN
      v) Factored moment Muy = 250 kNm
      vi) Effective length = 3.5 m
      vii) Unsupported length = 4 m.

5. a) What are the principles of earthquake resistant design? Write the ductile detailing provision for beam. [10]

   b) A reinforced concrete beam has 700 mm × 450 mm size 8 m span. It contains 6-25 mm bars in which two bars are bent at 45° near end of the support. Calculate the shear reinforcement if factored shear force at support is 400 kN. Use M 20 and Fe 415 steel. Draw the sketches also. [10]

***

BCE

06G TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

Regular / Back			
	E	Full Marks	80
	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of Reinforced Concrete Structures

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Four questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Prove that $S_v = \frac{087 f_y . A_{st} . d}{V_s}$ or $L_d = \frac{0.87 f_y . \phi}{4 \tau_{bd}}$. The symbols have their usual meanings. [5]

   b) A beam of 6m span is simply supported and carrying 24 kN/m live load and 3 kN/m dead loads excluding self weight. The beam is made of M20 concrete and Fe415 steel. Design the beam. Shear design is not required. [15]

2. a) Discuss briefly Limit State of Serviceability conditions. [5]

   b) Determine the reinforcement in a biaxially loaded column with the following parameters: [15]

   Size of column = 400mm × 600mm
   Factored load, P_u = 1500 kN
   Factored moment, M_{ux} = 300 kNm
   Factored moment, M_{uy} = 200 kNm

   Assume M25 concrete and Fe 415 steel.

3. a) Explain about detailing of reinforcement in staircases. [5]

   b) Design a reinforced concrete rectangular footing for a square column of size 450mm × 450mm, which is subjected to an axial load of 1650 kN and uni-axial moment of 240 kNm at service state. Consider allowable bearing capacity of soil as 120 kN/m^2. Show design summary and reinforcement detailing with neat sketch. [15]

4. a) What do you understand by splicing of bars? Write down the primary conditions for the application of splicing in reinforced concrete structures. [5]

   b) Design a two-way slab resting on RCC beams on all sides for a room having clear dimensions of 4m × 6m. The slab is subjected to a super-imposed live load of 2.5 kN/m^2 and floor finishes (screeds and flooring) load of 2.75 kN/m^2. Take M20 concrete grade and Fe415 steel grade. [15]

5. a) Draw idealized stress-strain curve for both steel and concrete and discuss on the design value of stresses. [5]

   b) A rectangular beam 180mm × 400mm is prestressed by a cable with an eccentricity of 75mm above the centroid at the supports and an eccentricity of 50mm below the centroid at the mid-span. Initial prestress is 900 N/mm^2 and area of the cable is 500mm^2. Calculate the prestressing force at the other end of the beam if its span is 10m. Assume μ = 0.50 and K = 0.0016/m. [15]

***

01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

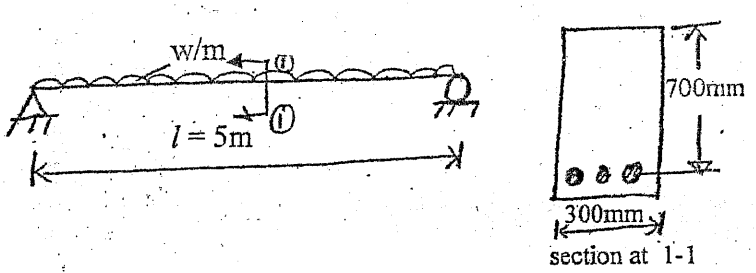
Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of Reinforced Concrete Structures *(EG722CE)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ *Assume missing data if necessary possibly complying to IS: 456-2000.*
- ✓ *Use of IS: 456-2000, IS: 1343 and SP-16 are allowed. But, use of SP-16 is allowed only for column design.*

1. a) Explain, in brief the types of load which is generally occurred in reinforced cement concrete structure design. [6]

   b) A reinforced concrete beam section of 300 mm width and 700 mm effective depth is reinforced with 3 bars of 20 mm as shown in figure below. Determine the moment of resistance and the maximum stresses induced in the materials. Take M20 concrete and Tor-steel. [14]



   *If the effective span is 5 m, also find the safe load, the beam will carry during service period. Use working stress method.

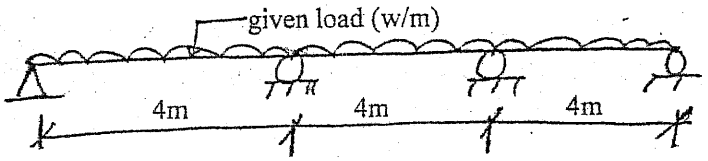
2. a) What do you understand by balanced section, under reinforced and over reinforced sections? Explain with neat sketch. [6]

   b) A cantilever beam 5 m span has to carry a superimposed load 5 kN/m. The beam has a constant cross section of 300 mm × 550 mm through the length. Determine the tension reinforcement if mild steel bars are to be used. Consider limit state design method. [14]

3. a) Why splices are required in RCC construction? [4]

   b) Design a column section with lateralties to carry an ultimate axial load of 2250 kN, and factored design moments of 150 kNm and 100 kNm about major and minor axes respectively. One of the dimensions of the column section is restricted to 300 mm. The materials to be used are: Concrete of grade M 25 and HYSD steel bars of grade Fe 415. Consider effective cover of 50 mm. [16]

4. a) A continuous one way slab consists of three equal spans of effective length 4 m each. The slab depth is assumed to be 110 mm. Take dead load as 3 kN/m^2 and imposed load 3 kN/m^2. Design critical section of slab for BM and sketch the slab reinforcement details. Take M20 grade concrete and Fe 415 grade of steel. [10]



Consider the self weight of slab also.

b) Find the thickness of an isolated footing for a rectangular column 35 cm x 45 cm carrying an axial load of 1200 kN. The net bearing capacity the soil is 110 kN/m^2. Take M20 concrete and Fe 415 steel. [10]

5. a) Explain different types of torsion in a RC structure. [6]

b) A simply supported reinforced concrete beam of span 16 m, 250 mm wide and over-all depth 550 mm is pre-stressed using a cable with cross sectional area of 250 mm^2. The cable profile is parabolic with an eccentricity of 75 mm above the centroid of the section at the end supports and 80 mm below the mid-span. If the cable is tensioned from one end only, estimate the percentage loss of pre-stress in the cable due to the effects of friction. Assume required constants suitably. [10]

c) Explain pre-stressing system with neat sketch. [4]

***

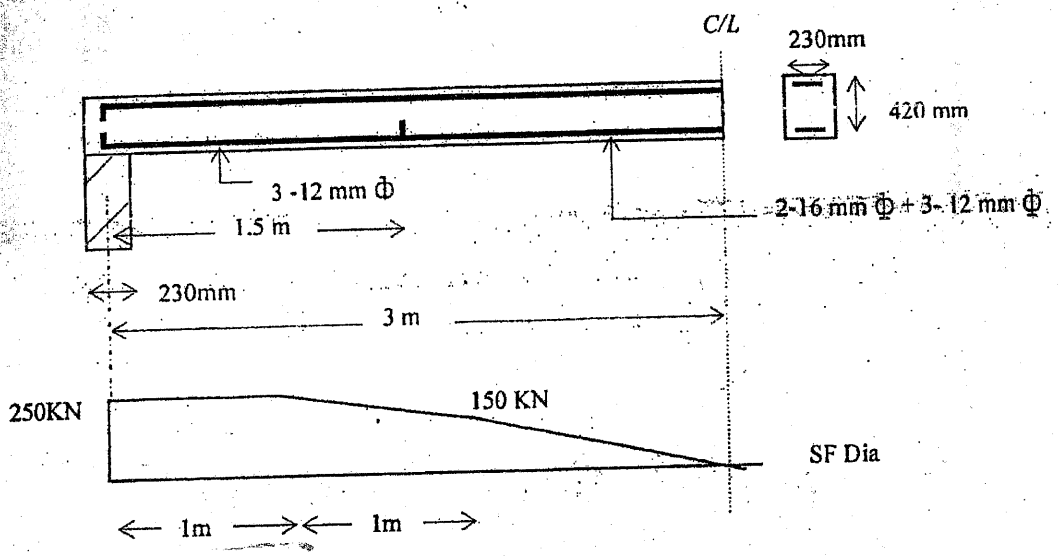
01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of Reinforced Concrete Structures *(EG722CE)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ *IS 456, IS 1343 and SP 16 are allowed to use.*
- ✓ *Notations given are of usual meaning.*

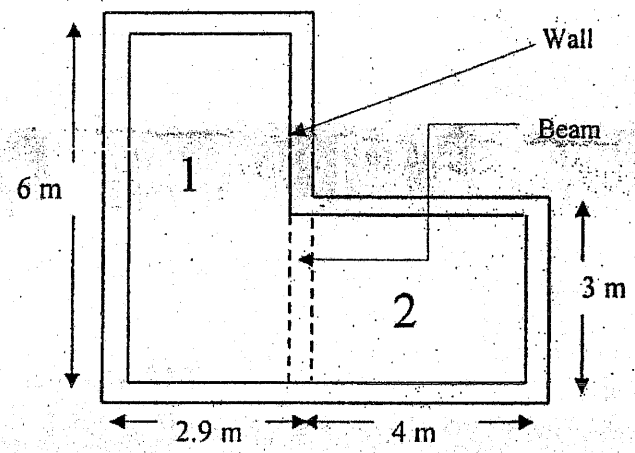
1. a) List the name of reinforcing bars available in Nepali Market. How these bars are characterized. Show stress strain diagram used in design of RC structures for these bars. [1+2+ 5]
   b) Design shear reinforcement for the reinforced concrete beam as shown in figure and show a neat sketch showing all reinforcement. Consider M25 and Fe 415 grade of concrete and steel respectively. [12]



2. a) Define under reinforced, over reinforced and balanced concrete section with respect to their depth of neutral axis, depth, moment resisting capacity and stresses in steel and concrete in working stress and limit state design method. [8]
   b) Design a column with transverse reinforcement, which is subjected to design bending moment of 300KN-m and design axial load of 700KN. Unsupported length of column is 4.75m and supports of column are rigidly fixed and effectively held in position. Consider M25 and Fe500 grade of concrete and steel. [12]

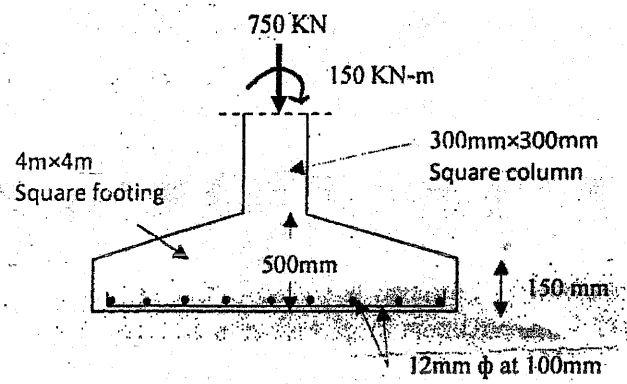
3. a) Derive mathematical expression for moment resisting capacity and depth of neutral axis of a T- beam when $x_u > D_f$ and $D_f \leq 0.43x_u$ [6]
Where, x_u – Depth of neutral axis, D_f – Thickness of flange

b) Briefly explain, how the slabs of the floor given in the diagram are designed. Design the slab panel '2' for bending and show arrangement of reinforcing bars. Take live load = 3.5 KN/m^2 and surface finish = 0.7 KN/m^2. [2+12]



4. a) Define development length. Show $L_d \leq 1.3M_l/V_u + L_o$ at support when end of beam contained compressive force. [2+6]
Where, L_d - Required development length, M_l - M. R. of beam at support
V_u- Design SF at support, L_o- Additional anchorage length at support

b) Check the depth of isolated footing (as shown in figure) in one way shear, two way shear and bending. Consider M25 and Fe 415 grade of concrete and steel and clear cover to reinforcement 40mm. [12]



5. a) What is prestressed concrete? Give its rationale. How losses of prestressing are assessed in the design of prestressed concrete structure? [10]
b) Describe how a beam section is designed, when it is subjected to torque, bending moment and shear force. [10]

***

BCE

04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Design of Reinforced Concrete Structures

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume missing data if necessary possibly complying to IS: 456-2000.*
- ✓ *Use of IS: 456-2000, IS: 1343 and SP 16 are allowed. But, use of SP-16 is allowed only for column design.*

1. a) A reinforced concrete column of a moment resisting frame has its cross section 400mm × 600mm and effective height 3.6m. The column has to carry loading combination of dead load, live load and moment due to wind load. The computed dead load and live load on column are 250 kN, and 100 kN respectively, whereas the induced horizontal load on column due to wind load is 5 kN/m. Calculate loading values for all possible loading combinations as per IS 456. [8]

   b) The moment of resistance of a rectangular reinforced concrete beam section having width b mm and overall depth D mm is $0.85bd^2$. The stresses in the extreme fiber of the concrete; and in the steel are not to exceed 7 N/mm^2 and 140 N/mm^2 respectively and the modular ratio equals to 18.33. Determine the ratio between the depth of neutral axis from the compression fiber and the effective depth of the beam. The beam is reinforced for tension side only. [12]

2. a) State all the possible safety and serviceability limit states to be considered in the design by Limit State Method. [5]

   b) Design an isolated square footing foundation of uniform thickness for a 400mm × 400mm column subjected to an axial load of 600 kN and a moment of 50 kNm at service state. Consider bearing capacity of soil as 150 kN/m^2 and concrete grade M20 and steel grade Fe415. [10]

   c) Draw idealized stress-strain curve for both steel and concrete and discuss on the design values of stresses. [5]

3. a) Write down the procedure for design of shear reinforcement. Also explain how the isolated footings are designed under punching shear? [8]

   b) Design the reinforcement required for a simple rectangular beam having effective span length of 6m. The beam is carrying 8 KN/m load from 120mm thick slab. Consider the width of beam 250mm and overall depth of beam to be 450mm. For loading calculation, consider live load on floor: 5 kN/m, floor finish: 3 kN/m, partition wall: 10 kN/m. M20 concrete and Fe415 steel are used. [12]

4. a) A concrete beam of 20m span, 200mm wide and 500mm deep is pre-stressed using a cable with cross sectional area of 250mm^2. The cable profile is parabolic with an eccentricity of 100mm above the centroid of the section at the end supports and 100mm below at the mid span. If the cable is tensioned from one end only, estimate the percentage loss of pre-stress in the cable due to the effects of friction. Consider m = 0.35 and k = 0.0015/m. Use the parabolic profile of the curve as $y = \frac{4e}{\ell^2} x(\ell - x)$. [12]

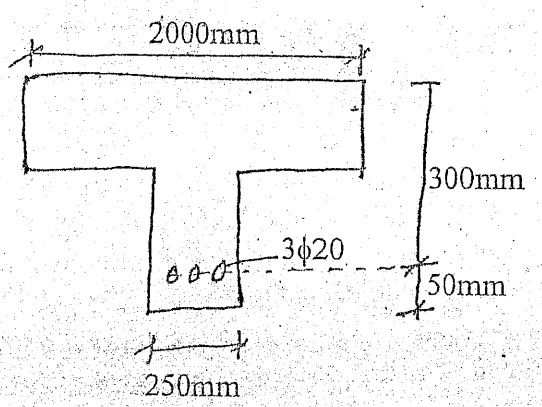
b) What do you understand by curtailment of tension steel in simple beams? Show by illustrating a neat sketch. [8]

5. a) Compare the factor of safety used in Working Stress Method and Partial Safety Factor used in Limit State Method for concrete and steel. [4]

b) Differentiate among the balanced, under reinforced and over reinforced section in a rectangular reinforced concrete section in limit state method with corresponding strain diagram. [8]

OR

Determine the moment of resistance of the section shown in figure below. Take $\sigma_{cbc} = 7$ N/mm^2 and $\sigma_{st} = 140$ N/mm^2. [8]



c) Design a square shaped reinforced concrete column that has to carry ultimate factored load of 800 kN inclusive of live load, at an eccentricity of 80mm in both X and Y directions. Use concrete grade M20 and steel grade Fe415. [8]

***

BCE – 07

03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

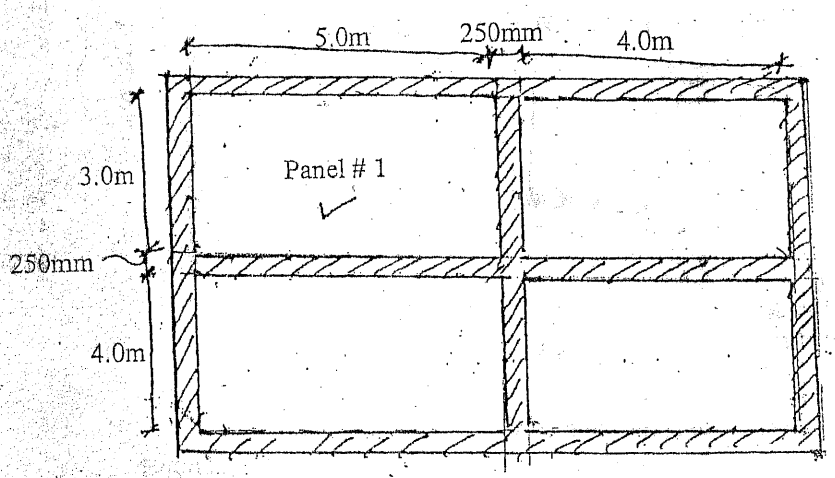
Subject: - Design of Reinforced Concrete Structures

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Four questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Use of IS: 456, IS 1343 are allowed. IS 456 SP-16 is allowed to design column only.*
- ✓ *Assume suitable data if necessary.*

1. a) What is the difference between working stress method and limit state method? Explain with stress and strain diagrams. [5]

   b) Design a simply supported rectangular beam with the effective span of 7m. The size of beam is required to be limited to 300mm × 700mm. Design shear reinforcement also. Take a live load of 70 kN/m. Use M20 concrete and Fe415 grade steel. [15]

2. The floor slab system of a two-storeyed building is shown in figure. The slab system is supported on 250mm wide beam as shown. Assuming a floor finish load of 1 KN/m^2 and a live load of 4 KN/m^2, design and detail the slab panel # 1 as indicated in the floor plan. Also check whether the section satisfies the deflection criteria. (Check for shear and development length not required). The torsional reinforcement should be designed. Use Fe415 steel. Assume mild exposure conditions. [12+4+4]



* The clear size of panel # 1 is 3.0x×5.0m as shown.

* Width of beam = 250mm

3. a) Explain the concept of design of a staircase. Show the detailing of reinforcement of straight flight in plan and section. [5]

   b) Determine the reinforcement equal in all sides of a biaxially loaded column with the following parameters. [15]

   Size of column = 400mm × 500mm
   Factored load, P_u = 1200 kN,
   Factored moment M_{ux} = 120 kNm,
   Factored moment M_{uy} = 100 kNm.
   M20 concrete and Fe 415 steel.
   d'/D = 0.15 for both axes.

4. a) Explain how an RC structural member subjected to torsion, shear force and bending moment is designed by IS code method. [6]

b) A simply supported beam of 6.0m span (c/c) as shown in figure, is to carry a Dead Load (DL) of 20 KN/m (including self wt. of beam) and Live Load (LL) of 30 KN/m. The width of the supporting wall is 230mm. The designed section of beam with longitudinal as well as shear reinforcements (vertical stirrups) are as shown. The grade of concrete used is M25 and steel is Fe415. If two of the tension reinforcement bars are terminated at 800mm from the centre of support, check the adequacy of shear strength at the bar cut off point. Suggest the suitable modification if required. [14]

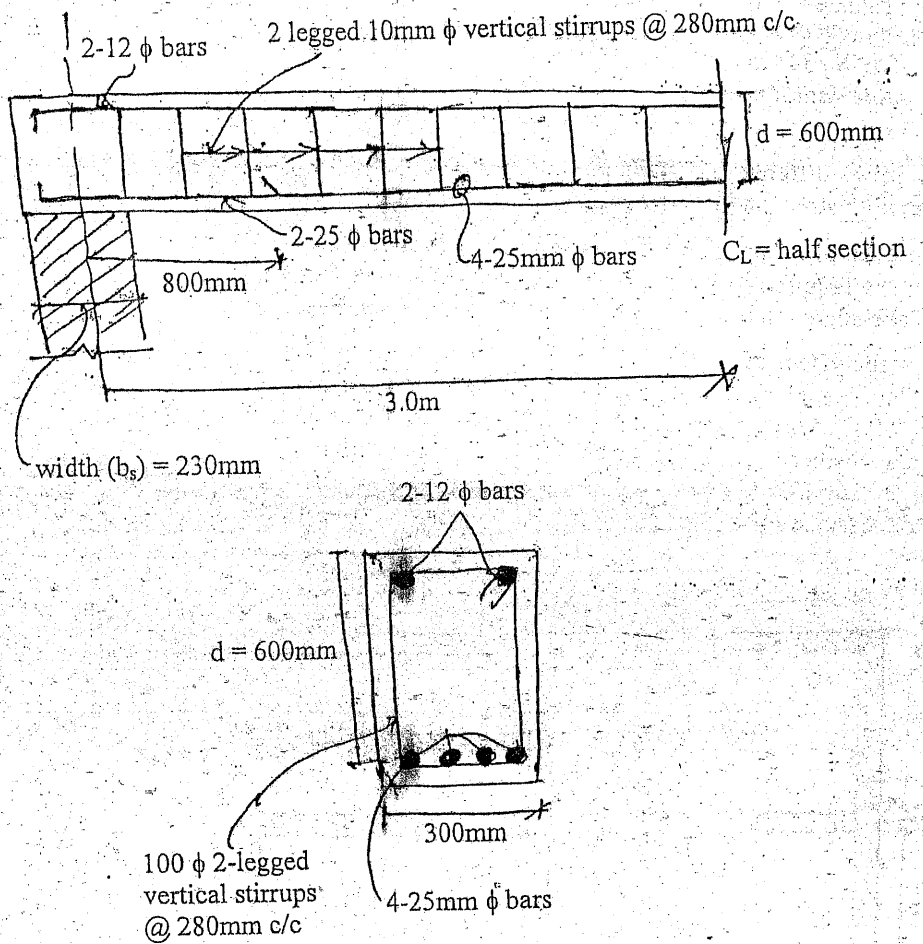


Figure: Section of beam

5. a) An isolated footing for a square column 450mm × 450mm, reinforced with 8-25mm ϕ bars, is carrying a service load of 2300KN. Assuming Fe415 steel and M20 concrete with safe bearing capacity of soil to be 300 KN/m^2, fix the size and depth of the footing. (Detailed design not necessary) [4+6]

b) A post-tensioned cable of a beam 10m long is initially tensioned to a stress of 1000N/mm^2 at one end. If the tendons are curves so that the slope is 1 in 24 at each end with an area of 600mm^2. Calculate the loss of prestress due to friction with the following data: [10]

Coefficient of friction between duct and cable, (μ) = 0.55
Friction coefficient for wave effect (K) = 0.0015/m

During anchoring if there is a slip of 3mm at the jacking end, calculate the final force in the cable and the percentage loss of prestress due to friction and slip.

***