INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

TUTORIAL QUESTION BANK

Course Name	:	Reinforced Concrete Structures Design and Drawing
Course Code	:	A50121
Class	:	IIIA & IIIB
Branch	:	CIVIL
Year	:	2017-2018
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OBJECTIVES

The objectives of this course are to impart knowledge and abilities to the students to:

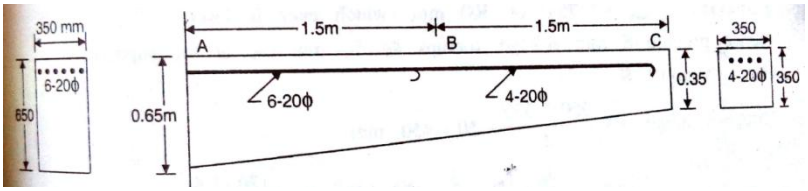
Civil Engineers are required to learn the fundamentals of design, analysis, and proportioning of reinforced concrete members and structures. Learn design concepts and modes of failure. Methods for analysis and design of these elements under flexure, shear, and axial loads will be examined. Learn how to make design decisions considering realistic constraints such as safety, economy and serviceability. Learn how to use the latest technology in solving structural analysis and design problems. To impart adequate knowledge on how to analyze and design reinforced concrete members and connection. To understand the mechanical properties of structural concrete. To understand the behaviour of reinforced concrete elements under normal force, shear, moment and torsion. Concept of ultimate design of reinforced concrete beams, floor systems and columns are to understood. To develop an understanding of and appreciation for basic concepts in the behavior and design of reinforced concrete systems and elements. To help the student develop an intuitive feeling about structural and material wise behavior and design of reinforced concrete systems and elements.

S No	QUESTION	Blooms taxonomy level	Course Outcomes
	UNIT - I **DESIGN CONCEPTS, DESIGN OF BEAMS**		
Part - A (Short Answer Questions)			
1	List different methods of design for reinforced concrete structural elements?	Understand	1
2	State four objectives of the design of reinforced concrete structure.	Understand	1
3	Explain the working stress method.	Understand	1
4	What do you mean by characteristic strength and characteristic load?	Understand	1
5	What are the different kinds of loads?	Understand	1

6	Explain the limit state method of design?	Understand	2
7	Differentiate between WSM and LSM.	Understand	2
8	List the different categories of limit state design.	Understand	2
9	Define the factored load.	Understand	3
10	Write a note on partial safety factors for material.	Understand	3
11	Explain the limiting moment of resistance	Understand	2
12	What is a doubly reinforced beam?	Understand	2
13	What do you mean by neutral axis?	Understand	2
14	What are the merits and demerits of Working stress method?	Understand	2
15	State assumptions made in limit stress method?	Understand	2
16	Give the idealized stress-strain curve for concrete and steel.	Understand	2
17	State the assumption for limit state design in flexure.	Understand	3
18	Explain the stress block parameters with necessary diagrams.	Understand	3
19	What are the modes of the failure for an RCC element?	Understand	3
20	What is the difference the singly and doubly reinforced beam?	Understand	3
Part - B (Long Answer Questions)			
1	Enumerate the five limit states commonly used in limit state design and state briefly how they are provided in the design.	Understand	1
2	State and explain the significance of the six assumptions of design of flexural members employed in limit state of collapse.	Understand	1
3	Draw the cross-section of singly reinforced rectangular beam and show the strain and stress diagrams.	Understand	1
4	Explain the limiting moment of resistance and give the expression for this value for Fe 250 and Fe 415 grade steel?	Understand	1
5	Explain the terms balanced, overreinforced and underreinforced section in bending. Explain which of these should be recommended in design.	Understand	2
6	Determine the depth of neutral axis for abeam section 250mmwide and 400mm deep (effective) . The beam is reinforced with 3 bars of 20mm diameter. Use f_{ck}= 20 N/mm^{2}and f_y= 415 N/mm^2.	Understand	2
7	Give the stress block parameters used in limit state method along with the stress diagram.	Remember	2
8	Calculate the ultimate moment carrying capacity of a rectangular beam with b=250 mm, d=350 mm, Ast=1800mm^2 assume grade of concrete M30 and Fe 250 steel.	Understand	2
9	A singly reinforced R.C.C BEAM 250 mm wide and 400 mm deep (effective) is reinforced with 4 bars of 16 mm diameter. Find the depth of neutral axis, limiting depth of neutral axis and specify the type of beam. Use f_{ck}=20 N/mm^2 and f_y=415N/mm^2.	Understand	3
10	Enumerate the steps of design of doubly reinforced beam.	Understand	3
11	What do you mean by neutral axis and leaver arm? Explain briefly with neat sketches.	Understand	3
12	Determine the area of steel required for the beam b=300mm, d=675 mm for carrying a factored moment of 185 kNm. Assume fy= 415 N/mm^2 and fck =20 N/mm^2	Understand	4
13	For T-beam of flange width 1200, depth100 mm and web clear depth 350,width 250 mm find reinforcement required for ultimate moment of 250 KN/m	Understand	4

14	Explain with figure balanced, under reinforced, over reinforced sections	Understand	4
15	A singly reinforced rectangular section is of b=150mm and d=350mm, tension steel consist of 3 nos. of high yield bars of 16 mm dia and stirrups are of mild steel 8mm dia. The cover provided to steel is 25mm assuming fck= 20 MPa. Determine the ultimate moment of resistance of section.	Understand	4
16	A singly reinforced beam of effective span 7.5m has to carry a characteristic live load of 15 KN/m and dead load of 20 KN/m, M20 grade concrete and Fe 415 steel are used in construction. a) Determine the maximum and minimum effective depth of the beam that can be permitted according to IS 456 for the above load, assuming deflection requirements need not be fulfilled and the breadth of the beam is 300mm. b) Design the beam for the above span and loading conditions as per IS code.	Understand	4
17	Derive the formulae for determination of steel areas of a doubly reinforced beam of given dimension to carry a given moment.	Understand	4
18	Design balanced singly reinforced concrete beam section for an applied moment of 60 KN-m, the width of the beam is limited to 175 mm. use M20 concrete and Fe 415 bars.	Understand	4
19	A T beam continuous over several supports has to carry a factored negative support moment of 1000 KN-m. determine the area of steel at supports if b_w = 400mm,b_f =1600mm, D_f=100mm, D=610 mm, d'=60mm, f_{ck}=30 MPa,f_y=415MPa	Understand	4
20	A doubly reinforced beam 250 x 450 mm is reinforced with four bars of 25mm dia on the tension side and 4 bars of 18 mm on compression side. Assuming an effective cover of 50 mm, M20 concrete and Fe 415 steel. Calculate the ultimate moment capacity of the section.	Understand	4
Part - C (Problem Solving and Critical Thinking Questions)			
1	Reinforced concrete beam of 230 mm X 500 mm effective is subjected to a factored moment of 200 KN m. Find the reinforcement required. Use M20 concreter and Fe 415 steel.	Remember	1
2	An R.C.C. beam 350 mm X 550 mm effective is subjected to a factored moment of 180 KN m. Find the reinforcement required. Use M20 concreter and Fe 415 steel.	Remember	1
3	A beam of 350 mm X 550 mm effective is subjected to a factored moment of 180 KN m. Find the reinforcement required. Use M20 concreter and Fe 415steel.	Remember	1
4	Calculate the ultimate moment of the resistance of an R.C beam of rectangular section 300mm wide and 600 mm depth the covers of both the reinforcement is 50 mm. Tension steel of 4-20mm diameter and compression steel of 4-12 mm diameter bars are provided. Use M20 concreter and Fe 415 steel.	Remember	1
5	A beam 300 mm X 500 mm effective depth is subjected to a factored moment of 170 KN m. Find the reinforcement required. Use M20 concreter and Fe 415 steel used d' =500 mm.	Remember	2
6	Design a rectangular beam of 250 mm X 500 mm effective depth is subjected to a factored moment of 160 KN m. Find the reinforcement required. Use M20 concreter and Fe 415 steel.	Remember	2
7	Design a rectangular beam of 300 mm X 450 mm effective depth is subjected to a factored moment of 200 KN m. Find the reinforcement required. Use M20 concreter and Fe 415 steel.	Remember	3

8	Design a rectangular beam of 325 mm X 550 mm effective depth is subjected to a factored moment of 220 KN m. Find the reinforcement required. Use M20 concreter and Fe 415 steel.	Understand	3
9	A beam 250 mm X 450 mm effective depth is subjected to a factored moment of 180 KN m. Find the reinforcement required. Use M20 concreter and Fe 415 steel used d' =500 mm.	Understand	3
10	A T-beam floor has 120mm thick slab supported on beams . The width of beam is 300 mm and effective depth is 580 mm. The beam is reinforced with 8 bars of 20mm diameter. Use M20 grade of concrete and Fe 415 steel. The beams are spaced 3 m centre to center. The effective span of beam is 3.6 m.	Understand	3
11	Find the moment of resistance of T-beam having , breadth of flange 740mm depth of beam is 400 mm 5-20 mm dia bars used as reinforcement, depth of flange 100 mm. Ues M15 grade concrete andfe250 steel.	Understand	3
12	A simply supported *T*-beam of 8 m span using M 20 and Fe 415 subjected to dead load of 9.3 kN/m and imposed loads of 10.7 kN/m at service. Calculate the short- and long-term deflections and check the requirements of IS 456.Cross Section dimensions B_f=2234mm b_w=300,D_f=100mm Overall depth of beam 700 mm reinforced with 2 nos of 25 mm dia and 2 nos of 16 mmdia.	Understand	3
13	Find the moment of resistance of T-beam having , breadth of flange 650mm depth of beam is 400 mm 4-20 mm dia bars used as reinforcement, depth of flange 100 mm. Ues M15 grade concrete andfe250 steel.	Understand	3
	UNIT - II **SHEAR, BOND & TORSION**		
Part – A (Short Answer Questions)			
1	State modes of shear failures in R.C beams?	Understand	4
2	Define ‘development length’?	Understand	4
3	Explain how bending shear stress produce tension cracks in concrete.	Understand	4
4	What is the expression for spacing of vertical stirrups in R.C. beams for shear?	Understand	4
5	What is meant by punching shear and how is it different from bending shear.	Understand	4
6	What are the types of reinforcements used to resist shear? Explain the action of different types of shear steel.	Understand	4
7	What are the Indian specifications for allowable shear in slabs?	Understand	4
8	What are the different regions of cracks in the beam?	Understand	4
9	What do you mean by bundling of bars? What is the maximum no of bars that can contribute to bundle?	Understand	4
10	What do you understand by nominal shear stress? Write the formula for uniform formulae for rectangular section?	Understand	4
11	What are the stresses produced by torsion?	Understand	4
12	State the spacing of shear reinforcement as per IS 456:2000	Understand	4
13	When do we require splicing in steel reinforcement?	Understand	4
14	Explain the terms bond and anchorage?	Understand	4
15	Explain the terms average bond stress and local bond stress?	Understand	4

16	Sketch the pattern of cracking in a beam under torsional moment. Explain the term torsional stiffness	Understand	5
17	What is short term deflection and what are the factors affecting it.	Understand	5
18	What are the major factors that affect deflection?	Understand	5
19	What are the methods allowable in IS code for control of crack width in RC beams?	Understand	5
20	What is basic span/depth ratio and state the codal provisions for cantilever, simply supported and continuous beams up to 10mts span.	Understand	5
Part - B (Long Answer Questions)			
1	Explain modes of failures in R.C beams?	Remember	4
2	Step by step design procedure for shear reinforcement.	Remember	4
3	A simply supported reinforced concrete beam is 250 mm wide and 500mm effective depth and is reinforced with 4-20 mm diameter as tensile steel. If the beam is subjected to a factored shear of 65 KN at the support. Find the nominal shear stress at the support. Use M20 concrete and Fe 250 steel.	Remember	4
4	What are the various remedial measures for control of cracking?	Remember	4
5	Explain the different types of shear reinforcement with neat sketches.	Remember	4
6	The T-beam and slab system of a structure are made of beams spaced at 2.4m with clear span of 7.5m between masonry walls of 300mm thick. For the T beam D_f= 120mm, b_w = 300mm, D= 600mm if fck= 20N/mm^2 and fy=415N/mm^2. Design the shear steel. Assume that two nos. 28mm bars of tensile steel are continued to support and LL=8KN/m^2	Remember	4
7	What are the IS 456:2000 code requirements for bond?	Remember	4
8	Design the shear reinforcement for a RC cantilever beam carrying a UDL of 80 KN/m inclusive of its own weight. Consider M20 grade of concrete and Fe415 steel .assume a cover 50mm to the center of reinforcement. 	Remember	4
9	Explain bond mechanism and bond stress with figure.	Remember	4
10	Explain the critical sections for design shear as per IS 456 with requisite sketches.	Remember	4
11	Explain the approaches for control of deflection in bending members as per IS 456. What are the measures for reducing deflection?	Remember	4
12	A tied column of a multistoried building has 32mm rods for longitudinal steel. Assuming fck=25N/mm2 and fy=415N/mm2 a) Calculate the lap length required b) State how this length can be reduced to make savings in steel consumption.	Remember	4

13	A reinforced concrete beam of 4m span requires 7 - Fe 415 bars of 16mm, as tension bars. Find the distance from the centre of the beam where the central bar can be curtailed. Assume fck=15N/mm2 and d=300mm.	Remember	4
14	What is nominal shear reinforcement? Give the reasons for providing minimum shear reinforcement.	Remember	4
15	Explain IS456 method of design of reinforced concrete members subjected to torsionalmoment.	Remember	4
Part – C (Problem Solving and Critical Thinking)			
1	A cantilever carrying a UDL as a b=150mm and effective depth of 260mm. The reinforcement consists of 4 – 16mm bars. If the factored total load is 75KN calculate a) maximum local bond stress and b) the anchorage length required. Assume fck=30N/mm2 and fy= 415N/mm^2.	Remember	4
2	A simply supported concrete beam is 250 mm wide, 500 mm effective depth and is reinforced with 5 bars of 18 mm diameter as tensile steel. If the beam is subjected to a factored shear of 140 KN at the support and two of the main bars are cranked up at $45^{0.}$ Find the spacing of two legged 6 mm diameter stirrups at support. Use M 20 concrete and Fe 250steel.	Remember	4
3	A simply supported beam is 6m in span and carries a characteristic load of 60KN/m. If 6 nos. of 20mm bars are provided at the centre of the span and 4 nos. of these bars are continued into the support, check the development at this support assuming grade 15 Concrete and Fe 415 steel.	Remember	3
4	A RC beam has an effective depth of 500 mm and a breadth of 350mm. It contains 4-25 mm bars out of which two bars are to be bent up at 45^0 near end of the support . Calculate shear resistance of the bent up bars and additional stirrups needed. If the factored shear of 350 kN at the support clear span of the beam is 6 m. Use M15 mix and Fe415 grade ofsteel	Remember	4
5	A simply supported reinforced concrete beam is 250 mm wide and 500mm effective depth and is reinforced with 4-20 mm diameter as tensile steel. If the beam is subjected to a factored shear of 65 KN at the support. Find the nominal shear stress at the support and design the shear reinforcement. Use M20 concrete and Fe250 steel	Remember	4
6	A rectangular beam, 300mm wide and 400mm deep is reinforced with 2 nos. 12mm dia bars at top and 2 nos. 16mm dia bars at the bottom, each provided at an effective cover of 40mm. Assuming concrete of M20 grade and steel of Fe 415 grade , determine the resistance of the beam in pure torsion.	Remember	4
7	Determine the reinforcement required for a rectangular beam section with the following data: Width of section= 300mm Depth of section=500mm Factored BM=65KNm Factored torsional moment= 40KNm Factored shear force=70KN, use M15 grade concrete and Fe415 grade steel.	Remember	4
8	A flanged beam of T section is simply supported over an effective span of 8m. the beam has effective flange width of 1400mm, thickness of flange as 150mm, bw = 300mm, effective depth =450mm. It is reinforced with 4 bars of 25mm dia in tension and 3 bars of 16mm dia in compression of Fe 415 grade. Check the beam for deflection, if the concrete is of M20 grade.	Remember	4
9	A slab of depth 150mm is designed for two way action over 5m x 6m. The reinforcement in short span consists of 12mm at 240mm spacing and that in the long span is 12mm at 320mm spacing. Check whether these satisfy IS456 rules for crack control.	Remember	4

10	A flanged beam of T section is simply supported over an effective span of 8m. The beam has effective flange width of 1200mm, thickness of flange as 160mm, bw = 250mm, effective depth =400mm. It is reinforced with 4 bars of 25mm dia in tension and 3 bars of 16mm dia in compression of Fe 415 grade. Check the beam for deflection, if the concrete is of M20 grade.	Remember	4
11	Determine the reinforcement required for a rectangular beam section with the following data: Width of section= 250mm Depth of section=450mm Factored BM=75KNm Factored torsional moment= 50KNm Factored shear force=90KN, use M15 grade concrete and Fe415 grade steel.	Remember	4
12	A reinforced concrete beam of 5m span requires 8 - Fe 415 bars of 16mm, as tension bars. Find the distance from the centre of the beam where the central bar can be curtailed. Assume fck=15N/mm^2 and d=400mm.	Remember	4
13	A simply supported beam of 12m span is provided with 1.6% tension reinforcement (no compression steel) the area of tension steel required by calculation is only 1.25%. Determine the depth of the beam for a) Fe500 and b) Fe415 steels if the deflection is to be within the safe limit.	Remember	4
14	A simply supported reinforced concrete beam is 220 mm wide and 400 mm effective depth and is reinforced with 5 bars of 18mm diameter as tensile steel. If the beam is subjected to a factored shear of 62.5 KN at the support. Find the nominal shear stress at the support and design the shear reinforcement. Use M20 concrete and Fe 415 steel.	Remember	4
15	The T-beam and slab system of a structure are made of beams spaced at 3m with clear span of 8m between masonry walls of 350mm thick. For the T beam Df= 150mm, bw = 350mm, D= 600mm if fck= 20N/mm2 and fy=415N/mm2. Design the shear steel. Assume that two nos. 28mm bars of tensile steel are continued to support and LL=10KN/m2	Remember	4

UNIT-III
DESIGN OF SLABS

Part - A (Short Answer Questions)

1	What is difference between one-way and two-way slabs?	Understand	5
2	Why do we need to provide cover in the design of reinforced concrete structures?	Understand	5
3	Give the unit weight of PCC and RCC.	Understand	5
4	Give the steps for checking deflection of two way slabs?	Understand	5
5	How is the maximum shear in two way slabs calculated?	Understand	5
6	What are the specifications as per IS code for Minimum and maximum reinforcement requirement for slabs.	Understand	6
7	What are the considerations that govern thickness of one way and two way slabs?	Understand	6
8	Which is the critical section to be considered for checking of shear in a slab support on beams?	Understand	6
9	Sketch the reinforcement detailing of one way slab.	Understand	6
10	Sketch the reinforcement detailing of one way slab.	Understand	6

11	Reinforcement requirement for ONE-WAY slabs as per IS: 456.	Understand	6
12	Reinforcement requirement for TWO-WAY slabs as per IS: 456.	Understand	6
13	Explain about canopy slabs?	Understand	6
14	What are the specifications for the design of slabs for shear as per IS 456?	Understand	6
15	What type of slabs are usually used in practice, underreinforced or overreinforced?	Understand	6
16	Explain the need for corner reinforcement in two way rectangular slabs whose corners are prevented from lifting up.	Understand	6
17	What is the minimum Flexural Reinforcement in Slabs in either direction?	Understand	6
18	Torsional reinforcement is required in which type of slabs and why?	Understand	6
	Part - B (Long Answer Questions)		
1	Write the procedure for design two way simply supported slabs.	Understand	5
2	Design a simply supported RCC slab for a roof of a hall 4m x 10 m with 230 mm walls all around assume a LL of 4 KN/m^2 and finish 1 KN/m^2. Use M 25 and Fe 415 steel.	Understand	5
3	Give neat sketches for the reinforcement details for one way simply support and two way continuous slabs.	Understand	5
4	Design the interior the span of continuous one way slab for an office floor continuous over T beams spaced at 4m centers. Assume f_{ck}=25N/mm^2 and Fe 415 steel	Understand	5
5	Design a RC slab for a room having inside dimension 3m x7m. The thickness of supporting wall is 300mm. the slab carries 75mm thick lime concrete at its top. The unit weight of which may be taken as 20 KN/m^3. The LL on the slab may be taken as 2KN/m2 assumes the slab to be simply supported at the ends use M20 and Fe 415.	Understand	5
6	Explain the difference in the behavior of one-way and two-way slabs.	Understand	6
7	What are the major factors which influence the crack width in flexural members?	Understand	6
8	Discuss the Design procedure for two way slab?	Understand	6
9	Design continuous RC slab for a hall 6.5 m wide and 13.5 m long. The slab is supported on rcc beams, each 240mm wide which are monolithic the ends of the slabs are supported on walls 300 mm wide. Design the slab for LL 2KN/m^2 assume weigth of roof finishing =1.5KN/m^2 use M20 ans Fe 415.	Understand	6
10	What are the various remedial measures for control of cracking?	Understand	6
11	Design a RC slab 6.3 m x4.5 m simply supported on all four sides it has to carry a LL is 10 KN/m^2 in addition to its dead weight assume M25 concrete and Fe 415 steel.	Understand	7
12	Design a R C slab for a room 4m x 5m from inside. The slab carries a LL of 2000 n/m2 and finished with 20 mm thick granolithic topping use M20 concrete and Fe 415 steel. The slab is simply supported at all four edges, with corners free to lift.	Understand	7

13	Design the RC slab for a room 5m x 6m .the slab is simply supported on four edges with corner held down and carriers a Superimposed load of 3000N/m2 inclusive of floor finish . use M20 and Fe 415 as per IS Code.	Remember	7
14	Give neat sketches for the reinforcement details for one way simply support and two way continuous slabs.	Remember	7
15	Explain IS: 456 code method for design of slab?	Remember	7
Part – C (Problem Solving and Critical Thinking)			
1	Design a one−way slab, with a clear span of 4.0 m, simply supported on 230 mm thick masonry walls, and subjected to a live load of 4 kN/m^2 and a surface finish of 1 kN/m^2. Assume Fe 415 steel. Assume the beam is subjected to moderate exposure conditions.	Remember	5
2	Design A cantilever slab having an overhang of 1.25m take load of intensity of 1000 N/m2 on the cantilever and the weight of the finishing as 800 N/m2 use m20 and Fe415.	Remember	5
3	Design a simply supported slab to cover a hall with internal dimensions 4.0 m× 6.0 m. The slab is supported on masonry walls 230 mm thick. Assume a live load of 3 kN/m2 and a finish load of 1 kN/m2. Use M 20 concrete and Fe 415 steel. Assume that the slab corners are free to lift up.	Remember	5
4	Design a R C slab for a room 5m x 4m from inside. The slab carries a LL of 21000 N/m2 and finished with 20 mm thick granolithic topping use M20 concrete and Fe 415 steel. The slab is simply supported at all four edges, with corners free to lift.	Remember	5
5	Design a RC slab 6 m x4.5 m simply supported on all four sides it has to carry a LL is 10 KN/m2 in addition to its dead weight assume M25 concrete and Fe 415 steel.	Remember	5
6	Design continuous RC slab for a hall 6.5 m wide and 13.5 m long. The slab is supported on rcc beams, each 240mm wide which are monolithic the ends of the slabs are supported on walls 300 mm wide. Design the slab for LL 2KN/m2 assume weigth of roof finishing =1.5KN/m2 use M20 ans Fe 415.	Remember	6
7	Design a simply supported RCC slab for a roof of a hall 5m x 10 m with 230 mm walls all around assume a LL of 4 KN/m2 and finish 1 KN/m2. Use M 25 and Fe 415 steel.	Remember	6
8	Design continuous RC slab for a hall 5 m wide and 12 m long. The slab is supported on RCC beams, each 230mm wide which are monolithic the ends of the slabs are supported on walls 300 mm wide. Design the slab for LL 3KN/m2 assume weigth of roof finishing =1.5KN/m2 use M20 ans Fe 415.	Remember	6
9	Design a slab of room of clear size 5.5 m X 4 m. The superimposed load is 5 kN/m2 use M-20 and Fe 415 grade of steel. The four edges of the slab are simply supported and there is no provision of torsion reinforcement (corners not held down). The width of the support is 300 mm.	Remember	6
10	Design a RC slab for a room measuring 5m x 6m size. The slab is simply supported on all four edges, with corners held down and carries a superimposed load of 3000N/m2, inclusive of floor finishes, etc, use M20 mix, Fe415 steel and IS code method.	Remember	6

15	Design a slab of room of clear size 6.5 m X 5 m. The superimposed load is 6 kN/m^2 use M-20 and Fe 415 grade of steel. The four edges of the slab are simply supported and there is no provision of torsion reinforcement (corners not held down). The width of the support is 200 mm.	Remember	4
UNIT-IV DESIGN OF COLUMNS			
Part – A (Short Answer Questions)			
1	Differentiate between column and pedestal.	Understand	7
2	What are the limits of percentage of the longitudinal reinforcement in a column?	Understand	7
3	Define effective length of column?	Understand	7
4	What is slenderness ratio? Explain.	Understand	7
5	What is the purpose of lateral ties in a RC column?	Understand	7
6	What is the difference between behavior of a short and long column?	Understand	7
7	Explain unsupported length of column?	Understand	7
8	Define equivalent length of a column.	Understand	7
10	What is the maximum slenderness ratio of reinforced columns allowed by IS:456-2000.	Understand	7
11	Explain braced and un braced column.	Understand	7
12	What is minimum diameter of bars used in longitudinal steel for columns?	Understand	7
13	Why high grade concrete mixes are recommended for reinforced concrete column?	Understand	7
14	What is the minimum eccentricity specified for design of column?	Understand	7
15	What are the methods available in IS: 456-2000 to determine the effective length of column?	Understand	7
16	What are the assumptions for limit state design of columns failing in pure compression as given in IS456?	Understand	7
17	Explain the modes of failure of columns.	Understand	7
18	Show the reinforcement detailing of spirally reinforced column.	Understand	7
19	What are the three methods available for design of columns subjected to P and M?	Understand	7
20	What are the factors that affect the behavior of slender columns?	Understand	7
Part – B (Long Answer Questions)			
1	Write the design procedure for slender columns for both braced and unbraced column.	Understand	7
2	Differentiate between Unsupported length and effective length of a compression member.	Understand	7
3	A column 400 x 400mm has an unsupported length of 7m and effective length of 4.5m. Can it be designed as a short column under axial compression, if the load is placed centrally on it?	Understand	7
4	Outline the procedure for design of axially loaded reinforced concrete column?	Understand	7
5	Design an axially loaded tied column 400 x 400 mm pinned at both ends with an unsupported length of 3m for carrying a factored load of 2300KN. Use grade M20 concrete and Fe 415 steel.	Understand	7

6	Derive the expression for the ultimate load for axially loaded short column.	Understand	7
7	Discuss the important provisions for design of longitudinal steel for columns as per IS 456.	Understand	7
8	Design a circular pin ended column 400mm dia and helically reinforced with an unsupported length of 4.5m to carry a factored load of 900KN. Assume M30 concrete and Fe 415 steel.	Understand	7
10	Discuss the important provisions for design of lateral ties for columns as per IS 456.	Understand	7
11	Explain the step-by-step procedure for design of centrally loaded short columns.	Understand	7
12	A concrete column is reinforced with 4 bars of 20 m dia. Determine the ultimate load capacity of the column, using M 20 grade concrete and Fe 415 grade steel, if the size of the column of the coli=umn is 450 mm x 450mm .what will be the allowable service load?	Understand	7
13	RC column 400mm x 600mm is subjected to an axial ultimate load of 3000N. The column is bent in single curvature about minor axis with ultimate moment M_y=100 N-m at top and M_y=125 N-m at bottom. Taking the unsupported length as 7 m and effective length as 5.6 m on both axes, compute the design moments for the column. Assume reduction factor k_a=1	Understand	7
14	Differentiate between i)Unsupported length and effective length of a compression member. ii) Braced and unbraced column.	Understand	7
15	How columns are classified on the basis of different criteria?	Understand	7
16	A column 300mm x 400 mm has an unsupported length of 3 m and effective length of 3.6 m. it is subjected to P_u=1100 KN; M_u=230KN-m about the major axes, determine the longitudinal steel using f_{ck}=25 N/mm^2 and f_y =415 N/mm^2 assume d'=60mm.	Understand	7
17	Determine the longitudinal steel required for column for 400 x 600 mm carrying Pu=166 KN, factored moment M(major axis)=120 KN-m and factored M(minor axis)= 90KN-m, assume f_{ck}=15 N/mm^2 and f_y =415 N/mm^2 assume d'=60mm.	Understand	7
18	Design the short circular column of the 500mm dia with the following data: Factored load=800 KN; Factored moment =162.5 KN-m provide hoop reinforcement take M20 and Fe415 steel.	Understand	7
Part – C (Problem Solving and Critical Thinking)			
1	Design a short axially loaded square column 500 mm x 500mm for a service load of 2000 KN. Use M 20 concrete and Fe 415 grade steel.	Remember	7
2	Design a circular column to carry an axial load of 1000 KN. Use M 20 concrete and Fe 415 steel.	Remember	7
3	An unbraced column 400 mm square is subjected to the following: factored loads p=3200 KN. At the top, M_x= 76 KN m and My=68 KN m. At the bottom, M_x= 8 KN m and My=34 KN m, Lo=5m; Le=6 m at the both axes. Assuming f_{ck}=40 and f_y=415 N/mm^2, design the longitudinal steel.	Remember	7

4	Design a circular column using helical reinforcement to carry an axial load of 1000 KN. Use M 20 concrete and Fe 415 steel.	Remember	7
5	Determine the maximum factored load carrying capacity of a square column 400mm x 400mm, reinforced with 8 bars of 25mm dia, uniformly spaced along all the four sides with an effective cover of 60mm. The column is braced against side sway and has unsupported length of 5.5m and effective length factor of 1 about both the aix. Assume M20 and Fe 415 steel.	Remember	7
6	Design a rectangular column of 4.5 m unsupported length, restrained in position and direction at both the ends, to carry an axial load of 1200 KN. Use M 20 concrete and Fe 415 steel.	Remember	7
7	A circular column, 4.6 m high is effectively held in poisyion at both the ends and restrained against rotation at one end. Design the column, to carry an axial load of 1200 KN, if its dia. Is restricted to 450 mm. use M 20 mix and Fe 415 steel.	Remember	7
8	An R C column 500 mm x 400 mm is subjected to an ultimate load of 2500 KN and bent in single curvature about the minor axis with M_y(top)= 90 KN-m and M_y(bottom) =120 KN-m as ultimate moments. If L_o =7.2 m and Le=5.75 on both axes, calculate the design moment for the column.	Remember	7
9	Design the short circular column of the 500mm dia with the following data: Factored load=800 KN; Factored moment =162.5 KN-m provide helical reinforcement take M20 and Fe415 steel.	Remember	7
10	Design a rectangular column of 5 m unsupported length, restrained in position and direction at both the ends, to carry an axial load of 1500 KN. Use M 20 concrete and Fe 415 steel.	Remember	7
	UNIT-V **DESIGN OF FOOTING, STAIR CASE**		
Part - A (Short Answer Questions)			
1	Give the classification of foundation.	Understand	8
2	Discuss the design of slab type of staircases.	Understand	8
3	Explain about one-way and two-way shear in footings.	Understand	8
4	Explain about combined footing.	Understand	8
5	Explain about the Minimum cover required in a footing.	Understand	8
6	Show how the pressure distribution beneath footings.	Understand	8
7	Give the provision of dowel bars as per IS: 456-2000 code of practice.	Understand	8
8	Explain shear and bond in footings.	Understand	8
9	Name five types of staircases based on geometrical configurations. Draw a typical flight and show: (a) Trade, (b) nosing, (c) riser, (d) waist and (e) going.	Understand	8
10	Explain about the following stair cases (A) A staircase (B) A dog leggedstair	Understand	8
11	Explain tread and rise in staircase?	Understand	8
12	Explain about isolated footing.	Understand	8
13	Explain deep foundation.	Understand	8
14	What are the types of combined footing?	Understand	8
15	Show the bending pattern of combined footings.	Understand	8

Part - B (Long Answer Questions)			
1.	What are the different types of foundations? Explain with fig.	Understand	8
2.	Explain design procedure for footing as per IS: 456.	Understand	8
3.	Explain pressure distribution under footing with figure.	Understand	8
4.	Explain about one-way and two-way shear in footings.	Understand	8
5.	Write notes on the following (a) Stair slab spanning longitudinal (b) Stair slab spanning horizontally.	Understand	8
6.	What are the Indian standard code recommendations for design of footings as per IS: 456-2000?	Understand	8
7.	Discuss the principles of design of slab type staircases with necessary diagrams.	Understand	8
8.	(a)Explain the distribution of loading on stairs with fig. (b) Explain the procedure for estimation of dead weight of stairs.	Understand	8
9.	Explain the design procedure for isolated footing of uniform depth.	Understand	8
10.	Give the procedure for one way and punching shear with necessary diagrams.	Understand	8
11.	Give the design of sloped square footing with reinforcement detailing.	Understand	8
12.	A solid footing has to transfer a dead load 1000 KN and imposed load of 400 KN from a square column 400 x 400 mm with 16 mm bars. Assuming f_y =415 N/mm^2 ;f_{ck}20 N/mm2 safe bearing capacity = 200 KN/m^2. Design the footing.	Understand	8
13.	Design a footing for a 500 x 350 mm column using 20 mm bars as dowels to transmit characteristic loads of 600 KN as dead load and 400 KN as live load to a foundation with SBC = 120 KN/m2, assume M20 and Fe415.	Understand	8
14.	Design a square slopped footing for a circular column 500 mm dia and intended to carry a load of 1000 KN, SBC= 200 KN/m2, assume M20 and Fe 415.	Understand	8
15.	A Staircase has following dimension : Waist W= 75 mm; Nosing N=25 mm; Rise R =175 mm; Going G=225mm. the LL is 2KN/m^2. calculate the factored load and effective depth if (a) Stair slab spanning longitudinal (b) Stair slab spanning horizontally	Understand	8
Part – C (Problem Solving and Critical Thinking)			
	A longitudinal type of staircase spans a distance of 3.75 m c/c beams, R=175 mm, G=250 mm , T=270 mm . The treads have 15 mm granolithic finish and consists of 50 steps. Assume M25 and Fe 415. Design a staircase for a LL of 5KN/m2. Assume breadth of staircase of 1.5 m.	Understand	8
	A straight stair in a residential building supported on wall on one side and stringer beam on the other side. The risers are 150 mm and treads are 250 mm and the horizontal span of the stairs may be taken as 1.2 m. design the steps. Use M 20 concrete and Fe 415 steel bars.	Understand	8

	Deign a dog- legged stair for a building in which the vertical distance between floors is 3.6 m. the stair hall measures 2.5 mx 5m. The live load may be taken as 2500 N/m2.use M 20 concrete and Fe415 steel bars.	Understand	8
	A straight stair in a residential building supported on wall on one side and stringer beam on the other side. The risers are 150 mm and treads are 250 mm and the horizontal span of the stairs may be taken as 1.5 m. design the steps. Use M 25 concrete and Fe 415 steel bars.	Understand	8
	Design a combined rectangular footing for two columns A and B, carrying loads of 500 and 700 KN respectively. Column A is 300 mm x 300 mm in size and column B is 400 mm X 400 mm in size. The center to center spacing of the columns is 3.4 m. the safe bearing capacity of soil may be taken as 150 N/m^2. Use M 20 concrete and Fe 415 steel.	Understand	8
	Design a rectangular isolated footing of uniform thickness for RC column bearing a vertical load of 600 KN and having a base size of 400 mm x 600 mm .The SBC of soil may be taken as 120 KN/m^2, use M 20 and Fe 415.	Understand	8
	Design an isolated square sloped footing for a column 500 mm x500 mm, transmitting an axial load of 1200 KN. The column is reinforced with 8 bars of 20 mm dia. SBC of soil is 120 tonnes/m2. Use M20 Fe 415.	Understand	8
	Design the combined trapezoidal footing for two columns A and B, spaced 5 m center to center. Column A 300 mm x300 mm in size and transmit a load of 600 KN. Column B is 400 x 400 mm in size and carries a load of 900 KN. The maximum length of footing is restricted to 7 m; the SBC of soil may be taken as120 KN/m^2, Use M 20 and Fe 415.	Understand	8
	Design an isolated square sloped footing for a column 500 mm x500 mm, transmitting an axial load of 1500 KN. The column is reinforced with 8 bars of 20 mm dia. SBC of soil is 120 tonnes/m2. Use M20 Fe 415.	Understand	8
	Design a combined rectangular footing for two columns A and B, carrying loads of 400 and 600 KN respectively. Column A is 300 mm x 300 mm in size and column B is 400 mm X 400 mm in size. The center to center spacing of the columns is 3.5 m. the safe bearing capacity of soil may be taken as 150 N/m^2. Use M 20 concrete and Fe 415 steel.	Understand	8

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