Design of Reinforced Concrete Structures (BE05006011)

B.E. Semester 5 (Civil Engineering)

Directorate of Technical Education
Gandhinagar, Gujarat

Lukhdhirji Engineering College, Morbi

Certificate

This is to certify that Mr./Ms. _____ _____ Enrollment No. _____ of B.E. Semester 5th Civil Engineering of this institute (GTU Code: 031) has satisfactorily completed the tutorial work for the subject Design of Reinforced Concrete Structures (BE05006011) for the academic year 20 - 20 .

Place: _____

Date: _____

Name and Sign of Faculty member

Head of the Department

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(Progressive Assessment Sheet)

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TUTORIAL – 1
INTRODUCTION

		COs	LEVEL
1	**Define** the aim of structural design.	1	U
2	**List out** various methods of structural design.	1	U
3	**Write down** the difference between Limit State Method (LSM) and Working Stress Method (WSM).	1	U
4	**Define** characteristic cube compressive strength of concrete (fck) and characteristic strength of steel (fy).	1	U
5	**Define** tensile strength of steel (fct).	1	U
6	**Write** advantage and disadvantages of RCC. **Why** steel is used as reinforcement in RCC**?**	1	U
7	**List out** the combination of loads as per IS-1893.	1	U
8	**Calculate** effective span for (a) Simply supported beam and slab (b) continuous beam and slab (c) cantilever beam as per IS 456(2000)	1	A
9	**Define** basic values of span to effective depth ratios for Cantilever beam, simply supported beam and Continuous beam (a) for spans up to 10m. (b) Spans above 10m**.**	1	A
10	**Explain** difference between column and strut.	1	U
11	**Explain** maximum diameter of bar used in slab.	1	U
12	**Define** nominal cover to reinforcement in slab, footing, column and beam in moderate condition.	1	U
13	**Define** max. and min. % of reinforcement required in beam.	1	U
14	**Define** (1) Balance section (2) Under reinforced section (3) Over reinforced section	1	U
15	**Explain** types of Load. **List out** various IS codes used for calculation of loads.	1	A

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TUTORIAL – 2
BEAMS

		COs	LEVEL
	Singly Reinforced Beam		
1.	For a limiting section 300mm x 600mm gross **Determine** the following if M-20 conc. Mix and fy = 415 N/mm^2 steel is used (i) Max. Compressive stress and max. Tensile stress (ii) Lever arm (iii) Total compression (iv) Total tension (v) Limiting moment (vi) Area of tensile steel.	2,5	A
2.	A RCC beam rectangular in section 230mm x 450mm effective is singly reinforced by 4 no. of 16 mm dia. Bars of fe-415 grade steel and M-20 grade of concrete. **Determine** moment of resistance of section.	2,5	A
3.	**Determine** moment of resistance for a beam 230mm x 350mm overall size and effective cover 40 mm. The beam is reinforced with 5 no. 16mm dia. Bars take fck=20 N/mm^2, fy=415 N/mm^2.	2,5	A
4.	A singly R.C. beam effective section 300mm x 600mm, provide with 3-20Φ + 3-16Φ at effective cover of 50 mm is simply supported 4.50 m. span. Use fck=20 N/mm^2, fy=415 N/mm^2. **Evaluate** safe load (L.L.) on beam.	2,5	A
5.	**Design** singly R.C. balance section for factored moment 225 kN-m. Use Fe-415 steel and M-20 grade of concrete. Take width to effective depth ratio for the beam 0.7.	2,5	N
6.	**Design** singly R.C. beam having width 230 mm, simply supported with effective span of 4.0m. it is loaded with a U.D.L. of 15 kN/m excluding self-weight. Use M-20 grade concrete and Fe-415 steel. Check the beam for max. and min. steel and deflection.	2,5	N
7.	**Explain** Stress -Strain diagram for singly Reinforced concrete beam. **Derive** equation of Moment of Resistant for balanced section.	1, 2	A
8.	**Determine** the moment of resistance of a beam section 230 mm X 600mm effective depth reinforced with 3- nos. 25 mm diameter bars. M20 grade concrete and Fe-250 steel reinforcement is used. Also find out the moment of resistance if the materials are M-20 and Fe -415. Comment on the answer.	2,5	N
	Doubly Reinforced Beam		
9	**Explain** necessity of doubly R.C. beam	1,2	A
10	A doubly reinforced beam of 300 mm x 600 mm overall is reinforced with 5-16 Φ bars as compression reinforcement and 5-20 Φ bars as tensile reinforcement. Effective cover on both sides is 50mm, grade of concrete M-25 and steel Fe-415. **Determine** (i) types of section (ii) Moment resistance capacity of the section.	2,5	A
11	A rectangular beam of size 200mm x 350mm effective depth is subjected to a factored moment of 150 kN-m. **Determine** the reinforcement for flexure. The effective cover for the tensile and compression steel are 50 mm. The materials are M-25 grade concrete and HYSD reinforcement of grade Fe-415.	2,5	A

12	**Evaluate** the area of tensile and compression reinforcement required for a rectangular beam of size 230mm x 500mm effective for the factored moment of 325 kNm. The effective cover for the tensile and compression steel is 50 mm. The materials are M-20 grade concrete and HYSD reinforcement of grade Fe-415.	**2,5**	**N**
	<u>T Beam</u>		
13	A RCC T-beam section reinforce for tension has the following data, Flange width = 1600 mm Thickness of Flange = 125 mm Effective depth = 700 mm Width of rib = 325 mm **Determine** the limiting moment of resistance of the section. Take M-20 concrete and Fe-415 steel.	**2,5**	**A**
14	**Calculate** limiting value of M.R. of T-beam with the following data, Flange width = 1900 mm Depth of Flange = 130 mm Effective depth of beam = 550 mm Width of web = 300 mm Take M-20 concrete and Fe-415 steel 4-no. of 25 mm dia.	**2,5**	**A**
15	**Determine** M.R. of T-beam with the following data, Flange width = 1500 mm Depth of Flange = 115 mm Effective depth of beam = 425 mm Width of web = 300 mm Take M-20 concrete and Fe-415 steel 5-no. of 20 mm dia.	**2,5**	**A**
16	**Determine** M.R. of T-beam with the following data, Flange width = 1500 mm Depth of Flange = 115 mm Effective depth of beam = 425 mm Width of web = 300 mm Take M-20 concrete and Fe-415 steel 5-no. of 20 mm dia.	**2,5**	**A**

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TUTORIAL – 3
SLABS

		COs	LEVEL
1	**Explain** various types of slabs with sketch.	2	A
2	**Design** and detail simply supported slab on 300 mm wide brick masonry for a clear room size 4 m x 10 m. use material grade M-20 and Fe-415. Take live load as 3.5 kN/m^2 and floor finish as 1 kN/m^2.	2,5	N
3	**Design** for the slab of the hall of school building 10× 8 m with provision of two intermediate beams 300 × 500 mm at a clear distance of 3.5 m. the slab is resting on four walls of 300 mm thick and carrying live load of 3.5 kN/m^2 . Show the details of reinforcement for the slab by sketch. Use M-20 and Fe 415.	2,5	N
4	A one-way continuous slab of 150 mm thickness resting on 300 mm wide brick masonry supports spaced at 4 m c/c. considering live load as 2.5 kN/m^2 and floor finish as 1 kN/m^2. **Design** and detail slab for span moment and support moment. Assume four spans of the slab. Take M-20 grade of concrete and Fe 415 grade of steel.	2,5	N
5	**Design** and detail Reinforced Concrete slab for a room 6m x 5m. The slab is to be cast monolithically over beams with corners held down. The width of supporting beams 230 mm. Slab carries superimposed load of 3kN/m^2. Use M20 and Fe415.	2,5	N

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TUTORIAL– 4
COLUMN

		COs	LEVEL
1	**(A) Classify** various types of columns based on its (a) Shape (b) Bracing system (c) Lateral and longitudinal reinforcement (d) Effective Length of column (e) Types of loading. (B) **State** the assumptions in design of compression member.	1,2	A
2	A reinforced shot column of 400 mm x 450 mm in cross section is to carry an axial factored load of 1680 kN **calculate** the area of steel required and the spacing of 8 mm dia. Lateral ties. Use concrete M-20 and steel Fe-415. Give detail sketch of the section.	2,5	A
3	A short RCC rectangular column of 300 mm x 450 mm is reinforced with 6no. Of longitudinal bars (4no. of 25 mm dia. And 2no. of 20 mm dia) **determine** load carrying capacity of the column if M-25 mix and fe-415 steel is used also design the column for lateral ties. Check the column for minimum eccentricity. Unsupported length of column is 3.20 m. Give detail sketch of the section.	2,5	A
4	**Design** rectangular RC column for an axial load 1500 kN use M-20 concrete and Fe-415 steel also check for eccentricity; unsupported length of column is 3.50 m.	2,5	N
5	**Design** a short circular column for an axial compressive factored load of 950kN. The grade of concrete M-25 steels Fe-415 it is to be provided with minimum reinforcement sketch the detail.	2,5	N
6	**Determine** the reinforcement of a column of size 400 x 400 mm is subjected to axial compressive load of 2000 kN and factored moment about one of the axis is 150 kNm. Assume the moment due to minimum eccentricity is less than applied moment. Use M20-Fe415.	2,5	A
7	**Determine** the reinforcement of a column of size 500 x 500 mm is subjected to axial compressive load of 2000 kN and factored moment Mux = 80 kNm and Muy = 60 kNm. Assume the moment due to minimum eccentricity is less than applied moment. Use M20-Fe415.	2,5	A

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TUTORIAL – 5
FOOTING

		COs	LEVEL
1	A rectangular column of size 230 x 600 mm is loaded with 900 kN characteristic load. The safe bearing capacity of soil is 200 KN/m^2. **Determine** the dimension of the footing for the following cases. a. If footing is square. b. If the footing has equal projection in all four sides. c. If the dimension parallel to the shorter side of column is restricted to 2 m. If the dimension parallel to the longer side is restricted to 2.5 m.	1, 2,5	A
2	**Design** an isolated square pad footing for a square column 300 x 300 mm for axial load of 1700 kN. Use concrete grade M-25 and fe-415 steel grade. Take safe bearing capacity of soil- 140 kN/m^2. Also draw neat sketch.	2,5	N
3	**Design** a rectangular isolated sloped footing for a column of size 230 x 600 mm carrying an axial characteristic load of 1800 kN and reinforced with 8 nos 20 dia. Bars in M-25 grade concrete. The allowable bearing pressure on soil is 250 kN/m^2. The materials for footing are grade M-25 concrete and HYSD reinforcement of grade Fe-415.	2,5	N

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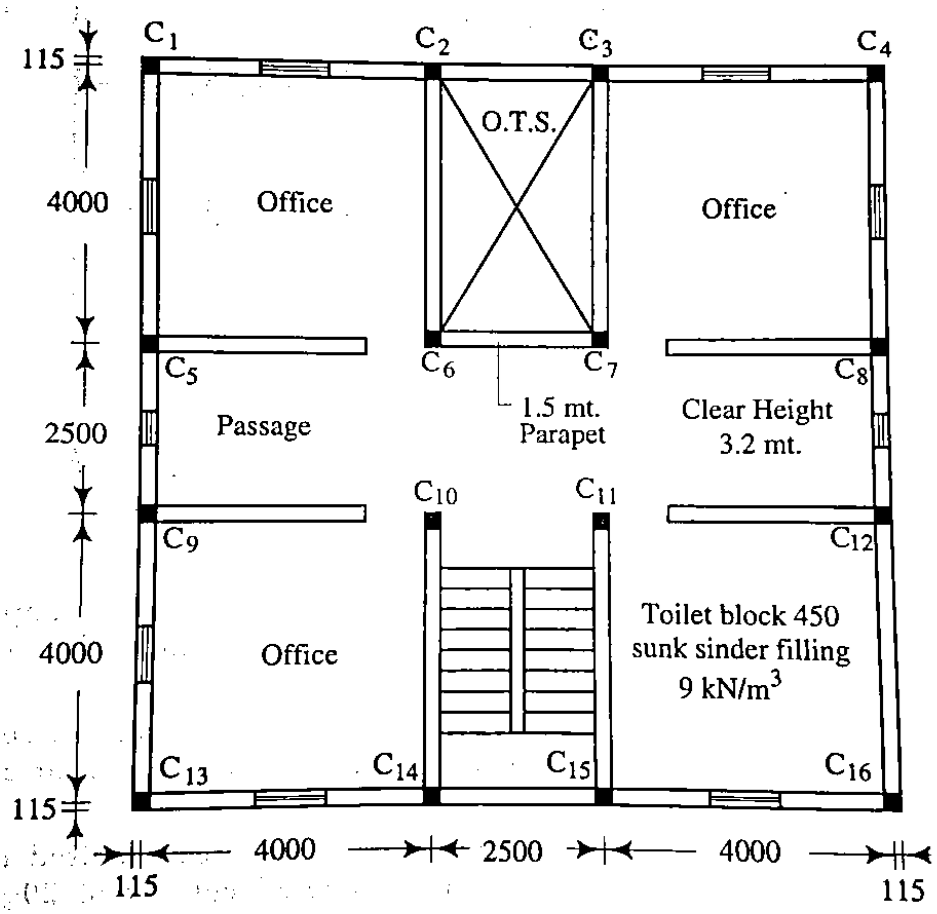
TUTORIAL – 6
BOND, DEVELOPMENT LENGTH AND SHEAR REINFORCEMENT

		COs	LEVEL
1	Explain anchoring of reinforcement.	2	A
2	A simply supported R. C. C. beam with clear span of 5m, support width 230 mm, size of beam 230 wide and 420mm deep, tension bars as 4nos. of 16mm dia. bars and clear cover of 25mm. If it is loaded by an all-inclusive factored udl of 60kN/m, **Design** the shear reinforcement near support only using 2 legged 6mm. mild steel stirrups.	1,2,5	N
3	**Explain** various types of shear reinforcement with sketch.	1,2,5	A

TUTORIAL – 7
BUILDING LAYOUT AND DESIGN

		COs	LEVEL
1	**Explain** the flow of loads in a Building. Also define a framed structure.	3	A
2	What are secondary and main beams? How will you calculate self-weight of slab and beam?	2,3	A
3	List down the guidelines for preparing the structural layout of the building taking into consideration the economy and aesthetic features. Also explain the guidelines for positioning and orientation of column in framed structure.	3	N
4	**Prepare** structural layout of the typical floor plan given below. Design G+3 building manually and make detailing in A2 size drawing sheet covering all required details in structural drawing. Live load on terrace = 1.5 kN/mm^2 and on floor = 4 kN/mm^2. Assume floor height = 3.5 m and all floor slab thickness = 130 mm. Make detailing for all beams, columns, slabs and foundation with staircase. Students can use spreadsheet for the design purpose. Design the same building using any of the structural software. Minimum one continuous beam, slab, column and footing manual calculation should be verified with the software results.  	3,5	E
5	**Prepare** structural layout and nominate all the members like slabs, beams, columns of G+3 building (whole structure) of having 4 bays of 5 m in X –direction and 4 bays of 3 m in Y-direction.	3,5	E

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TUTORIAL – 8
DESIGN OF RETAINING WALL

		COs	LEVEL
1	**Define** Retaining wall. Explain the purpose of the retaining wall.	4	A
2	**Discuss** briefly various types of retaining walls and situations where a particular type is used.	4	A
3	When is the counterfort retaining wall preferred as a structure? Also explain the structural behaviour of counterforts in a counterfort retaining wall.	4	A
4	**State** the stability checks in design of retaining wall.	4	A
5	**Design** and detail in A2 size drawing sheet for a cantilever retaining wall to retain the earth 4.2 m high for the following data: Top surface is horizontal behind the wall. Unit weight of soil = 17 kN/m^3, Angle of internal friction = 30^0, safe bearing capacity = 150 kN/m^2, Coefficient of friction between base and soil = 0.55. Use M20 –Fe 415.	4,5	N
6	**Design** a counterfort retaining wall has a height of retaining earth of 6.2 m. Top surface is horizontal behind the wall. Unit weight of soil = 16.2 kN/m^3, Angle of internal friction = 30^0, safe bearing capacity = 150 kN/m^2, Coefficient of friction between base and soil = 0.6. Use M20 –Fe 415.	4,5	N

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TUTORIAL – 9
DESIGN OF WATER TANK

		COs	LEVEL
1	**Design** and draw the reinforcement details for an underground circular tank for the following data: Diameter of the tank is 5.0 m; Depth of water is 2.5 m. The wall and base slab are not monolithic with each other. Use M30 grade of concrete and Fe415 grade of steel for design of the tank.	4,5	E
2	**Design** and draw the reinforcement details for an underground rectangular water tank for the following data: Dimensions of the tank is 4m x 10m x 3m; The subsoil consists of sand having angle of repose of 30^0 and saturated unit weight of 17 kN/m^3. The water is likely to rise up to ground level.	4,5	E

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TUTORIAL – 10
RCC MEMBER DETAILING

		COs	LEVEL
1	**Prepare** a sketch book with at least 10 sketches of different RCC members with detailing.	5	E