Course Code: 20CE0119 **R20**

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code: Structural Design (20CE0119) **Course & Branch**: B.Tech - Civil

Year & Sem: III-B.Tech & I-Sem **Regulation:** R20

UNIT –I
RCC STRUCTURES, BEAMS AND LIMIT STATE OF SERVICEABILITY

1	a) State the assumptions made in limit state of collapse in bending for the design of a reinforced concrete section.	[L2][CO1]	**[6M]**
	b) Draw the stress and strain distribution for singly reinforced beam and derive expression for depth of neutral axis, lever arm and moment of resistance with respect to concrete and steel	[L2][CO1]	**[6M]**
2	A singly reinforced concrete beam 250mm x 550mm is reinforced with 3# of 20mmϕ with an effective cover of 50mm. The beam is cantilever over a span of 3m. Find the safe uniformly distributed load the beam can carry. Use M20 grade concrete and Fe415 grade steel. Use limit state method	[L3][CO1]	**[12M]**
3	A singly reinforced concrete beam of section 200mm x 400mm is reinforced with 4# of 16mmϕ. The beam is simply supported over a span of 3m. Find the safe UDL (excluding self-weight) the beam can carry. Use M20 grade concrete and Fe415 grade steel	[L3][CO1]	**[12M]**
4	A simply supported beam of rectangular section of span 4m, carries a 'udl' of 10 kN/m over the entire span. Design the beam using M20 grade concrete and Fe415 HYSD bar	[L4][CO1]	**[12M]**
5	A reinforced beam of rectangular section 300mm x 450mm has reinforcement of 6# of 20mmϕ as tension reinforcement and 2# of 16mmϕ as compression reinforcement. Find the ultimate moment of resistance of the beam using M20 grade concrete and Fe250 grade steel. Assume effective cover as 35mm.	[L3][CO1]	**[12M]**
6	A double reinforced beam of 230mm x 500mm overall depth, is reinforced with 4# of 16mmϕ as compression reinforcement, 6# of 20mmϕ as tension reinforcement. The effective cover is 40mm. Find the safe 'udl' that the beam can carry, if it is simply supported over a span of 6m. Use M20 grade concrete and Fe415 grade steel.	[L3][CO1]	**[12M]**
7	Design the reinforcement for a clear span of 4000mm; super imposed load or live load is 30 kN/m and the size of beam is 250mm x 400mm. Use M20 grade concrete & Fe415 HYSD bars,width of support is 300mm, assume cover as 40mm.	[L4][CO1]	**[12M]**
8	A reinforced concrete beam of size 230mm x 450mm overall, carries a 'udl' of 20 kN/m excluding self-weight, the effective span of beam is 5.5m. Design the reinforcement for the beam. Use M20 grade concrete and Fe500 steel assuming an effective cover of 40mm	[L4][CO1]	**[12M]**
9	Design a rectangular simply supported beam over a clear span of 6m, carries a super imposed load of 15 kN/m and the support width is 230mm. Use M20 grade concrete and Fe415 steel. The beam has a width of 300mm. Design the reinforcement and do the check for deflection	[L4][CO1]	**[12M]**
10	A T-beam of effective flange width of 740mm, thickness of slab 100mm, width of rib 240mm and effective depth 400mm is reinforced with 5# of 20mmϕ bars. Determine the moment of resistance of the section. The materials are M15 grade concrete and Fe250 grade steel.	[L4][CO1]	**[12M]**

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UNIT –II
DESIGN FOR SHEAR, TORSION & BOND AND DESIGN OF RC SLAB

1	A reinforced concrete beam of rectangular section has a width of 250mm and an effective depth of 500mm. The beam is reinforced with 2# of 25mmϕ on the tension side. Two of the tension bars are bend up at 45° near the support section. In addition, the beam is provided with two legged stirrups of 8mmϕ at 150mm c/c near the support. If f_{ck} = 25 N/mm^2 and f_y = 415 N/mm^2, estimate the ultimate shear strength of the support section.	[L3][CO2]	**[12M]**
2	A reinforced concrete beam of rectangular section 300mm wide is reinforced with 4# of 25mmϕ at an effective depth of 600mm. The beam has to resists a factored shear force of 400kN at support section. Assume f_{ck} = 25 N/mm^2 and f_y = 415 N/mm^2, design the vertical stirrups for the section.	[L4][CO2]	**[12M]**
3	Design a rectangular simply supported RC beam over a clear span of 6m, if the super imposed load is 12 kN/m and the support width is 230mm. Use M20 grade concrete and Fe415 steel. The beam to have a width of 300mm. Design the shear reinforcement and do the check for deflection	[L4][CO2]	**[12M]**
4	A reinforced concrete section 200mm x 400mm is subjected to a characteristics torsional moment of 2.5 kNm and a transverse shear of 60 kN. Use M25 grade concrete and Fe415 HYSD bars. Determine the required reinforcement	[L4][CO2]	**[12M]**
5	Design a singly reinforced beam of width 230mm simply supported over a clear span of 3.5m. The width of the supports is 230mm and it carries a live load of 22 kN/m. Use M20 grade concrete and Fe415 grade steel. Also check for development length.	[L4][CO2]	**[12M]**
6	Design a simply supported RCC slab for an office floor having clear dimension of 4m x 10m with 230mm wall all-round. Use M20 grade concrete & Fe415 steel, live load on slab as 4 kN/m^2 & weight of weathering coarse over slab is 1.5 kN/m^2	[L4][CO2]	**[12M]**
7	Design a reinforced concrete slab to carry a live load of 3 kN/m^2 on an effective span of 3.5m. Use M20 concrete & Fe415 steel. Assume floor finish as 1 kN/m^2	[L4][CO2]	**[12M]**
8	Design a two-way slab for a room 4m x 3.5m clear in size, if live load is 3kN/m^2 and floor finish of 1kN/m^2. The edges of the slab are simply supported and corners are not held down. Use M20 grade concrete and Fe415 grade steel.	[L4][CO2]	**[12M]**
9	Design a two-way slab for a room of size 4m x 5m with discontinuous and simply supported edges on all the sides with corners prevented from lifting to support a live load of 4 kN/m^2 and weight of weathering course over the slab is 0.6 kN/m^2. Adopt M20 grade concrete and Fe415 grade steel.	[L4][CO2]	**[12M]**
10	Design a dog legged stairs for an office building in a room measuring 2.8m x 5.8m clear, vertical distance between the floors is 3.6m, width of flight is to be 1.25m. Allow a live load of 3 kN/m^2. Use M20 grade concrete and Fe415 steel. Assume the stairs are supported on 230mm walls at the end of outer edges of landing slabs. Assume necessary data if required	[L4][CO2]	**[12M]**

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UNIT –III
DESIGN OF RC COMPRESSION MEMBERS AND DESIGN OF RC FOUNDATION

1	Design a short axially loaded square column 500mm x 500mm for a service load of 2000 kN. Use M20 grade concrete and Fe415 HYSD bars	[L4][CO3]	**[12M]**
2	Design a circular column to carry an axial load of 1000 kN. Use M20 grade concrete and Fe415 steel.	[L4][CO3]	**[12M]**
3	Design the reinforcement in a column of size 400mm x 600mm, subjected to an axial working load of 2000 kN. The column has an unsupported length of 3m and is braced against side sway in both directions. Use M20 grade concrete and Fe415 steel.	[L4][CO3]	**[12M]**
4	Design the longitudinal and lateral reinforcement in a rectangular reinforced concrete column of size 300mm x 400mm subjected to a design ultimate load of 1200 kN and an ultimate moment of 200 kN.m with respect to the major axis. Use M20 grade concrete and Fe415 HYSD bars	[L4][CO3]	**[12M]**
5	Design the reinforcements in a short column 400mm x 600mm subjected to an ultimate axial load of 1600 kN together with ultimate moments of 120 kN.m and 90 kN.m about the major and minor axis respectively. Use M20 grade concrete and Fe415 steel.	[L4][CO3]	**[12M]**
6	A reinforced concrete column of size 300mm x 300mm carries a load of 750 kN. The safe bearing capacity of soil is 200 kN/m^2. Design an isolated column footing with uniform thickness. Use M20 grade concrete and Fe415 steel.	[L4][CO4]	**[12M]**
7	Design a rectangular isolated footing of uniform thickness for reinforced concrete column bearing a vertical load of 600 kN having a size of 400mm x 600mm. The safe bearing capacity of soil is taken as 120 kN/m^2. Use M20 grade concrete & Fe415 grade of steel.	[L4][CO4]	**[12M]**
8	Design a square footing of uniform thickness for a reinforced concrete circular column of diameter 400mm carrying an axial load of 1000 kN. The safe bearing capacity of soil is 200 kN/m^2. Use M20 grade concrete and Fe415 steel.	[L4][CO4]	**[12M]**
9	A reinforced concrete column 400mm x 400mm supports an axial service load of 1000 kN. The safe bearing capacity of soil at site is 200 kN/m^2. Adopting M20 grade concrete and Fe415 HYSD bars, design a suitable footing for the column and sketch the details of reinforcements	[L4][CO4]	**[12M]**
10	Design a reinforced concrete footing for a rectangular column of section 300mm x 500mm supporting an axial factored load of 1500 kN. The safe bearing capacity of soil at site is 185 kN/m^2. Adopt M20 grade concrete and Fe415 HYSD bars.	[L4][CO4]	**[12M]**

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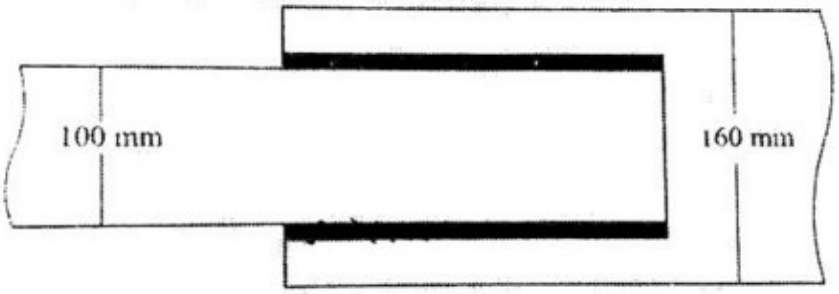
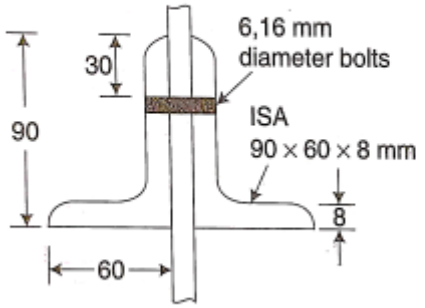
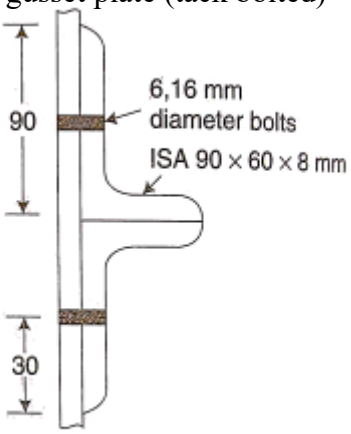
UNIT –IV
STEEL STRUCTURES, CONNECTIONS AND TENSION MEMBERS

1	a) Explain various types of structural steel used in construction	[L2][CO5]	**[6M]**
	b) Discuss on various mechanical properties of structural steel	[L2][CO5]	**[6M]**
2	a) Define bolting & explain various terminologies used in bolting	[L2][CO5]	**[6M]**
	b) Explain various types of bolted connections with neat sketch	[L2][CO5]	**[6M]**
3	Calculate the strength of a 20mmϕ bolt of grade 4.6 for the following cases. The main plates to be joined are 12mm thick i) For a lap joint ii) For single cover butt joint with the cover plate being 8mm thick. iii) Double cover butt joint with each cover plate being 8mm thick	[L2][CO5]	**[12M]**
4	Two plates 10mm and 18mm thick are to be joined by double cover butt joint. Design the joint for the following data. i) Factored design load = 750 kN ii) Bolt diameter = 20mm iii) Grade of steel = E250 iv) Grade of bolt = 4.6 v) Cover plates (2-one @ each side) = 8mm thick	[L3][CO5]	**[12M]**
5	a) Define welding. Explain various types of weld connection with neat sketch	[L2][CO5]	**[6M]**
	b) A groove weld is to connect two plates 180mm x 18mm each. Determine the design bending strength of the joint, if it is subjected to a moment of 13 kNm. Also determine adequacy of the joint, if the shear force at the joint is 200 kN. Assume weld is double-U shop welded & f_w = 250MPa.	[L3][CO5]	**[6M]**
6	a) What are the advantages & disadvantages of welded connections	[L1][CO5]	**[6M]**
	b) Design a suitable longitudinal fillet weld to connect the plates as shown in the figure to transmit a pull equal to the full strength of small plate. Given plates are 12mm thick, grade of plate Fe410 and welding to be made in workshop.  	[L3][CO5]	**[6M]**
7	a) A 18mm thick plate is jointed to 16mm plate by 200mm long (effective) butt weld. Determine the strength of joint if i) A double V-butt weld is used. ii) A single V-butt weld is used.	[L3][CO5]	**[6M]**
	b) A tie member of a roof truss consists of 2 ISA 90mm x 60mm x 10mm subjected to a pull of 600 kN, the angles are connected to a gusset plate of 12mm thick. Design the fillet weld with ultimate shear stress of 330 MPa.	[L3][CO5]	**[6M]**

8	Determine the tensile capacity of the section shown below if i) Angles are placed on the opposite sides of gusset plate (tack bolted) ii) Angles are placed on the same side of gusset plate (tack bolted) iii) Angles are not tack bolted.   (a) Angles on opposite side of gusset plate (b) Angles on same side of gusset plate	[L3][CO5]	**[12M]**
9	Compute the tensile strength of an angle section ISA 150mm x 115mm x 8mm of Fe410 grade of steel connected with the gusset plate as shown in the figure for the following cases: i) gross section yielding ii) net section rupture	[L3][CO5]	**[12M]**
10	Design a double angle tension member connected on each side of a 10mm thick gusset plate, to carry an axial load of 375 kN. Use 20mm black bolts. Assume shop connection	[L4][CO5]	**[12M]**

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UNIT –V
DESIGN OF COMPRESSION MEMBERS AND DESIGN OF BEAMS

1	An ISA 100mm x 100mm x 6mm (f_y = 250 N/mm^2) is used as a strut in a truss. The length of the strut, between the intersections at each end, is 3m. Calculate the strength of the strut if i) It is connected by two bolts at each end ii) It is connected by one bolt at each end	[L3][CO6]	**[12M]**
2	A column 4m long has to support a factored load of 6000 kN. The column is effectively held at both ends and restrained in direction at one of the ends. Design the column using beam section and plates	[L4][CO6]	**[12M]**
3	Design a single angle discontinuous strut to carry a factored axial compressive load of 65 kN. The length of the strut is 3m between intersections. It is connected to a 12mm thick gusset plate by 20mmϕ 4.6 grade bolts. Use steel of grade E250.	[L4][CO6]	**[12M]**
4	Design a double angle discontinuous strut to carry a factored load of 135 kN resulting from combination from wind load. The length of the strut is 3m between intersections. The two angles are place back-to-back (with long legs connected) and are tack bolted. Use steel grade of E250 i) Angles are placed on opposite sides of 12mm gusset plate ii) Angles are placed on same side of 12mm gusset plate.	[L4][CO6]	**[12M]**
5	Design a built-up column with 4-angles. The column is 12m long & supports a factored axial compressive load of 700 kN. Ends of column are held in position & restrained against rotation. Design a lacing system. Use steel of grade Fe410.	[L4][CO6]	**[12M]**
6	Design a laced column with two channels back-to-back of length 10m to carry an axial factored load of 1400 kN. The column may be assumed to have restrained in position but not in direction at both ends. (hinged ends).	[L4][CO6]	**[12M]**
7	Design a battened column with two channels back-to-back of length 10m to carry an axial factored load of 1400 kN. The column may be assumed to have restrained in position but not in direction at both ends. (hinged ends).	[L4][CO6]	**[12M]**
8	Design a simply supported beam of effective span 1.5m carrying a factored concentrated load of 360 kN at mid span.	[L4][CO6]	**[12M]**
9	Design a simply supported beam of 10m effective span carrying a factored load of 60 kN/m. Depth of beam should not exceed 500mm. Compression flange of beam is laterally supported by floor construction. Assume stiff end bearing is 75mm.	[L4][CO6]	**[12M]**
10	Design a laterally supported beam of effective span 6m for the following data. i) Grade of steel = E250 ii) Maximum bending moment (M) = 150 kNm iii) Maximum shear force (V) = 210 kN.	[L4][CO6]	**[12M]**

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