

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058



END SEM/RE-EXAM EXAMINATION -MAY / ~~JUNE~~ 2026

Program: Civil Engineering *Third Year B.tech* Duration: 3hr

Course Code: PC-BTC601

Maximum Points: 100

Course Name: Construction Engineering and Management

Semester: VI

Instructions:

Sem VI 19/5/26

1. Question no. 1 is compulsory
2. Attempt any 4 questions out of remaining 6 questions.
3. Neat diagrams must be drawn wherever necessary.
4. Assume Suitable data if necessary and state it clearly.

Q. No.		Questions	Points	CO	BL	Module
1	a	A construction company purchases 25,000 bags of cement annually.	6	CO3	BL3	4
		Each bag of cement costs ₹ 450 and the cost incurred in procuring each lot is ₹ 200. The cost of carrying is 25%. i) What is the most economic order quantity? ii) What is the average inventory level? iii) If the lead time of procuring cement is 2 weeks, determine the reorder point				
	b	Define lean construction. Identify the different types of waste in the context of high-rise construction project and their consequences	7	CO3	BL2	5
	c	Define BIM, brief about its dimension and discuss uses of BIM.	7	CO3	BL2	5
	a	A contract is awarded to you for the construction of rigid pavement road project in a metro city Mumbai.	20	CO1 CO2 CO3	BL2	2,4,5 & 6
2		i) Draw WBS for the project. ii) Suggest suitable organization structure for the same. iii) List the records to be maintained on the site for construction of rigid pavement road construction project. iv) Discuss the causes of accidents in the construction of rigid pavement road project and their mitigation measures.				
	a	It is proposed to carry out Concreting work for High-rise building in New Mumbai, discuss and draw PDCA cycle in the context of same.	8	CO3	BL3	6
3	b	Design a site layout plan for a High-rise building construction project indicating batching plant, storage, labour camp, and equipment yard.	6	CO2	BL3	4
	c	Discuss TBT and its importance in the context of safety management.	6	CO4	BL3	6

4	a	The following network shows a three time estimates for each activity.	9	CO2	BL3	3																																										
	<table><tr><th>Activity</th><th>t opt.</th><th>t mean</th><th>t pess.</th></tr><tr><td>1-2</td><td>3</td><td>6</td><td>15</td></tr><tr><td>1-6</td><td>2</td><td>5</td><td>14</td></tr><tr><td>2-3</td><td>6</td><td>12</td><td>30</td></tr><tr><td>2-4</td><td>2</td><td>5</td><td>8</td></tr><tr><td>3-5</td><td>5</td><td>11</td><td>17</td></tr><tr><td>4-5</td><td>3</td><td>6</td><td>15</td></tr><tr><td>5-8</td><td>1</td><td>4</td><td>7</td></tr><tr><td>6-7</td><td>3</td><td>9</td><td>27</td></tr><tr><td>7-8</td><td>4</td><td>19</td><td>28</td></tr></table>						Activity	t opt.	t mean	t pess.	1-2	3	6	15	1-6	2	5	14	2-3	6	12	30	2-4	2	5	8	3-5	5	11	17	4-5	3	6	15	5-8	1	4	7	6-7	3	9	27	7-8	4	19	28		
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6-7	3	9	27																																													
7-8	4	19	28																																													
i) Determine critical path and total duration. ii) Calculate standard deviation and variance iii) Find the probability that the jobs on the critical path will be completed in 41 days? iv) Find the probability that the jobs on the critical path will be completed by the due date of 41 days? (Tabulate your answer)																																																
b	On a highway project, a worker slips but is unhurt, another suffers minor injury, and a third case involves a fatal accident. Classify each as incident, near-miss, or accident, and propose preventive measures.		8	CO4	BL2	6																																										
c	Differentiate -AOA and AON		3	CO2	BL2	3																																										
5	a	Prepare A, B and C ranking of the different items for the data given below .Graph is mandatory.	10	CO2	BL3	4																																										
	<table><tr><th>Item no</th><th>No. of units</th><th>Unit cost ₹</th><th>Item no</th><th>No. of units</th><th>Unit cost ₹</th></tr><tr><td>1</td><td>7000</td><td>5.0</td><td>7</td><td>60000</td><td>2.0</td></tr><tr><td>2</td><td>24000</td><td>3.0</td><td>8</td><td>3000</td><td>4.0</td></tr><tr><td>3</td><td>1500</td><td>10.0</td><td>9</td><td>300</td><td>8.0</td></tr><tr><td>4</td><td>600</td><td>22.0</td><td>10</td><td>29000</td><td>1.0</td></tr><tr><td>5</td><td>38000</td><td>3.0</td><td>11</td><td>11500</td><td>8.0</td></tr><tr><td>6</td><td>40000</td><td>4.0</td><td>12</td><td>4100</td><td>9.0</td></tr></table>						Item no	No. of units	Unit cost ₹	Item no	No. of units	Unit cost ₹	1	7000	5.0	7	60000	2.0	2	24000	3.0	8	3000	4.0	3	1500	10.0	9	300	8.0	4	600	22.0	10	29000	1.0	5	38000	3.0	11	11500	8.0	6	40000	4.0	12	4100	9.0
	Item no	No. of units	Unit cost ₹	Item no	No. of units	Unit cost ₹																																										
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3	1500	10.0	9	300	8.0																																											
4	600	22.0	10	29000	1.0																																											
5	38000	3.0	11	11500	8.0																																											
6	40000	4.0	12	4100	9.0																																											
b	Prepare a checklist for Brick work, Pre-slab casting work		10	CO2	BL3	6																																										
	For the data given perform CPM calculations		10	CO2	BL2	3																																										
6	<table><tr><th>Activity Item</th><th>Duration in days</th><th>Immediate preceding activities</th><th>Immediate following activities</th></tr><tr><td>A</td><td>3</td><td>None</td><td>B,C</td></tr><tr><td>B</td><td>2</td><td>A</td><td>D,E</td></tr><tr><td>C</td><td>3</td><td>A</td><td>E</td></tr><tr><td>D</td><td>5</td><td>B</td><td>E</td></tr><tr><td>E</td><td>6</td><td>D,C</td><td>F,G</td></tr><tr><td>F</td><td>5</td><td>D,E</td><td>None</td></tr><tr><td>G</td><td>4</td><td>E</td><td>None</td></tr></table>		Activity Item	Duration in days	Immediate preceding activities	Immediate following activities	A	3	None	B,C	B	2	A	D,E	C	3	A	E	D	5	B	E	E	6	D,C	F,G	F	5	D,E	None	G	4	E	None														
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	E	6	D,C	F,G																																												
	F	5	D,E	None																																												
G	4	E	None																																													
i. Draw network diagram ii. Determine EST,LST, EFT and LFT. iii. Calculate total project duration, and indicate critical path. iv. Calculate TF,FF, Ind. Float and Int. Float																																																

	b	It is proposed to carry out concreting work for high-rise building project, differentiate quality control and quality assurance.	5	CO2	BL2	6																																													
	c	It is proposed to carryout construction of New Hostel block in Bhavan's campus. List out the project participant as well as equipment required in the construction of hostel Building.	5	CO1	BL2	1,2																																													
7	a	Optimize the project duration for the data given	12		BL3	7																																													
		<table><tr><td></td><td colspan="2">Normal</td><td colspan="2">Crash</td></tr><tr><td>Activity</td><td>Time, days</td><td>Cost ₹</td><td>Time, days</td><td>Cost ₹</td></tr><tr><td>1-2</td><td>4</td><td>600</td><td>3</td><td>800</td></tr><tr><td>1-3</td><td>2</td><td>400</td><td>2</td><td>400</td></tr><tr><td>1-4</td><td>5</td><td>750</td><td>4</td><td>900</td></tr><tr><td>2-3</td><td>7</td><td>400</td><td>5</td><td>600</td></tr><tr><td>2-5</td><td>7</td><td>800</td><td>6</td><td>1000</td></tr><tr><td>3-5</td><td>2</td><td>500</td><td>1</td><td>650</td></tr><tr><td>4-5</td><td>5</td><td>600</td><td>4</td><td>850</td></tr></table>		Normal		Crash		Activity	Time, days	Cost ₹	Time, days	Cost ₹	1-2	4	600	3	800	1-3	2	400	2	400	1-4	5	750	4	900	2-3	7	400	5	600	2-5	7	800	6	1000	3-5	2	500	1	650	4-5	5	600	4	850				
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4-5	5	600	4	850																																															
	Indirect cost per day for the project is ₹ 200/-																																																		
	a) Draw network, Find critical path.																																																		
	b) Find the normal duration and cost of the project.																																																		
	c) Draw time scaled diagram for each stage of crashing.																																																		
	d) Determine optimum duration and corresponding cost of the project.																																																		
	e) Draw the graph of direct cost, indirect cost and total cost.																																																		
	b	Justify the statement that construction projects of Mumbai-Pune missing link is a unique project.	4	CO1	BL1	1																																													
	c	Discuss the benefits of construction automations along with suitable examples.	4	CO1	BL2	1																																													



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End Semester Exam May 2026/Re-Exam - July 2026

Third Year
Program: B.Tech -Civil Engineering

Course Code: PC-BTC602

Course Name: Design of Steel Structures

Sem - VI

Duration: 3 Hour

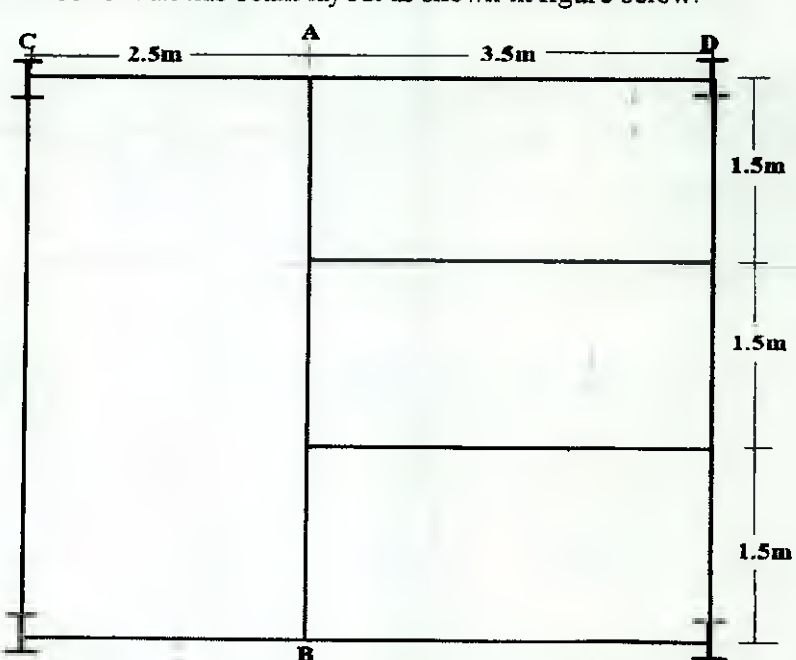
Maximum Points: 100

Semester: VI

21/5/26

Notes:

1. Attempt any 5 main questions. Answers to all sub-questions should be grouped together
2. Assume any missing data and state the same clearly
3. Use of IS 800-2007 and steel tables is allowed
4. Draw neat sketches to illustrate your answers
5. For all steel plates and angles, $f_y = 250\text{MPa}$, $f_u = 410\text{MPa}$

Q.No.	Questions	Points	CO	BL	Module
1	A floor of hall has beam layout as shown in figure below:  RCC slab depth = 150mm; Floor finish load = 1.5kN/m^2 Live load = 2.5kN/m^2; Wall thickness = 230mm All beams support walls of height 2.5m <i>Assuming the beam to be laterally supported - Design beam AB. Design connection between beam AB and CD (beam CD is of ISMB 500)</i>	20	1,3,4	4	1,6,7
2	The member of a roof truss carries the following unfactored loads - DL = 80kN (Tensile); LL = 45kN (Tensile);	20	1,2,3	4	1,2,3,4

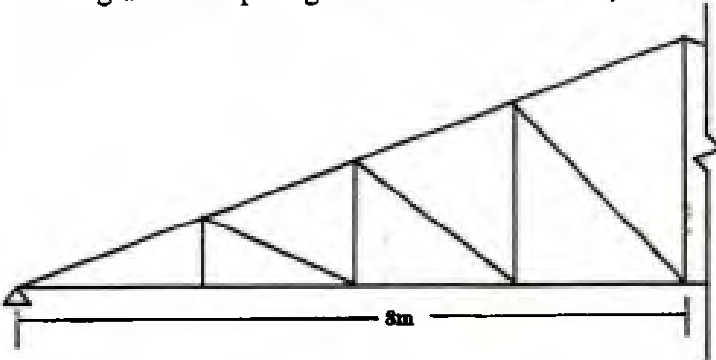


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End Semester Exam May 2026/Re-Exam – July 2026

	WL = 60kN (Compressive) a. What will be the design loads as per IS 800:2007 load combinations? b. Design the element as a tension member and also design its connection with 10mm thick gusset plate using 4.6grade bolts c. Check the member designed above for the safety in compression according to the appropriate load combinations. Length of member = 1.85m				
3.a)	A single angle strut (loaded through single leg) carries a design compressive force of 127kN. The length of member between centres of intersection is 1.95m. Design the section as per IS 800:2007. Assume the connection to be hinged with two bolts at each end	10	2	3	3
3.b)	Design a welded connection for a single angle tension member ISA 125x125x10. The angle is subjected to an axial force of 220kN. Assume shop welds.	10	2	3	1
4.	Design a built up laced column to carry 1750kN design axial load using two channels facing back to back. Also design lacing and its connection using 4.6grade bolts. The column is hinged at both ends and the length is 3.75m. Draw neat sketch showing all the details	20	2	3	3
5.a)	Design a stiffened seat connection for an ISMB 300 to transfer 95kN factored reaction to ISHB 400 using 4.6grade bolts. Draw neat sketch to show connection details	15	4	3	7
5.b)	Evaluate the load at each panel point due to live load for the following details : Spacing between trusses = 6.5m; Rise = 4m 	05	1,3	3	1,4
6.a)	Design a gusseted base connection for a column of section ISHB 300 to transfer a design load of 950kN on a concrete pedestal of M20 grade. Use 4.6 grade bolts of 20mm diameter.	12	3	3	5
6.b)	A column carries a design axial load of 1410kN. Design the column section using rolled steel section when both ends are restrained against rotation and translation. Length of member is 3.85m	08	3	3	3



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7.a)	Briefly explain the various limit states considered in design of steel structures.	05	1	2	1
7.b)	Explain the advantages and disadvantages of using steel as a structural material	05	1	2	1
7.c)	A simply supported beam ISMB 450 has been used over a span of 4.5m to carry a design load of 30kN/m. Check the safety of the beam in <i>shear, flexure and deflection</i> when the beam is <i>laterally unsupported</i>	10	3	4	6



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A

END SEMESTER May 2026 / RE-EXAM July 2026

Program: Civil Engineering

Third Year B.tech

Duration: 3 Hours

Course Code: PC-BTC603

Civil

Maximum Points: 100

Course Name: Foundation Engineering

Sem-VI

Semester: VI

Note:

1. Question 1 is compulsory. Attempt any four out of remaining six questions
2. Write units everywhere. Use $\gamma_w = 9.81 \text{ kN/m}^3$
3. Make reasonable assumptions where required and state them clearly. Justify where possible.
4. CO: Course Outcomes, BL: Blooms Level Taxonomy

26/5/26

Q. No.	Questions	Points	CO	BL	Module No.
1a.	For the design of a basement wall of a high rise structure, would you use at-rest, active or passive pressure? Justify your answer. For a soil with friction angle of 31° , determine the coefficient of lateral pressure at-rest, active, and passive conditions	5	1	2,4	1
1b.	Discuss the factors you would consider while deciding the depth of embedment of a shallow foundation.	5	3	3	3
1c.	Calculate the efficiency of a group of 3x4 piles constructed in clay having cohesion of 12 kPa. The piles are 350 mm in dia and 19 m long with spacing of 3d. What would you consider the efficiency if the same pile group is driven in sand ($\phi=32^\circ$) at another site?	5	4	4	4
1d.	What is CPRF? Explain how it is a sustainable and economic foundation system.	5	3,4	3	5
2a.	Determine the maximum and minimum pressure under the base of a cantilever retaining wall shown in Fig. 1. The soil parameters are $c=0$, $\phi=35^\circ$ and $\gamma=17.6 \text{ kN/m}^3$ and the angle of friction at the base may be taken as 32° . Assuming $\gamma_{\text{concrete}}=24 \text{ kN/m}^3$ and no friction between soil and stem of wall, also estimate the factor of safety against sliding. Comment on the values if allowable bearing capacity is 150 kN/m^2 .	10	2	4	2
2b.	A square footing of width 2.2 m is constructed at a depth of 2 m below ground surface in a layer of NC clay having unconfined compressive strength of 52 kPa. The ground water table is observed at a depth of 1.5 m below GS. The bulk unit weight of the clay is 16.8 kN/m^3 and saturated is 19.1 kN/m^3 . Assuming the load to be vertical and neglecting depth factor, determine the ultimate capacity of the system as per IS code recommendations.	10	3	3	3
3a.	Briefly describe the procedure for conducting a pile load test as per IS2911 (Part 4): 2013. Discuss how the results are interpreted	10	4	3	4



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A

END SEMESTER May 2026 / RE-EXAM July 2026

3b.	A deep excavation is made for the construction of an underground metro station. It is stabilized using struts as shown in Figure 2. The soil is medium dense sand with unit weight of 19.2 kN/m^3 and friction angle of 36° . Draw the apparent pressure diagram and determine the strut loads if the struts are placed at 3 m centre to centre along the length of the excavation.	10	1, 2	3	5
4a.	For a project in the dry regions of Marathwada region, a retaining wall is proposed near an embankment that carries a water pipeline. The contractor is refusing to add drainage blanket behind the retaining wall as it is increasing the project cost. As the site engineer for the project, would you accept his proposal to eliminate the drainage blanket? Justify your reasons.	5	2	4	2
4b.	Draw a typical under reamed pile and explain where it is most useful. Also explain what reticulated micro piles are and explain one application.	5	4	3	4
4c.	A 6 m high retaining wall retains soil with cohesion 8 kPa and friction angle 26° . The unit weight of the soil is 18.2 kN/m^3 . Calculate the active pressure on the wall if cracks occur and if cracks do not occur. Under passive conditions, will you expect cracks to occur? Explain why.	10	1	4	1
5a.	Discuss the factors that make ground improvement a good choice at a particular construction site.	5	3,4	4	5
5b.	Explain the Housel method to estimate allowable bearing capacity.	5	3	3	3
5c.	An 8 m high retaining wall retains a 5.5 m deep layer of sand with $\gamma_d = 18.5 \text{ kN/m}^3$ and $\phi = 34^\circ$ which is underlain by saturated sandy clay with $\gamma_{sat} = 20.3 \text{ kN/m}^3$, $\phi = 22^\circ$ and $c = 17 \text{ kPa}$. The GWT is at the interface of the two layers. Draw the lateral pressure distribution (including hydrostatic pressure) if the wall is moving away from the backfill.	10	1	3	1
6a.	Differentiate between general, local and punching shear failure	6	3	3	3
6b.	Describe the limitations of a plate load test	4	3	3	3
6c.	A 12 m long pile with diameter 400 mm is driven in a sandy deposit having $\phi = 30^\circ$, bulk density 1.8 g/cc , saturated density 1.93 g/cc , $\tan \delta = 1.02$, and $N_q = 30$. If GWT is at 4 m below GS and critical depth is 15d, estimate the safe pile capacity as per IS 2911	10	4	3	4
7a.	Draw the typical earth pressure distribution diagram for a cantilever sheet pile retaining sandy soil.	4	2	3	2
7b.	Using the simplistic method, determine the embedment depth of a sheet pile retaining 6 m of granular soil. The soil has unit weight of	6	2	2	5



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END SEMESTER May 2026 / RE-EXAM July 2026

	18.8 kN/m ³ , $\phi = 28^\circ$. The ground water table is very deep below.				
7c.	In a two layered cohesive soil, bored piles of 500 mm diameter are installed. The top layer has a thickness of 5.5 m and lower layer has considerable depth. The undrained cohesion for top layer is 31 kPa and that of bottom layer is 73 kPa. Design the pile length to carry a load of 400 kN assuming adhesion value for both layers to be 0.52 and factor of safety as 2.5.	10	3	3	6

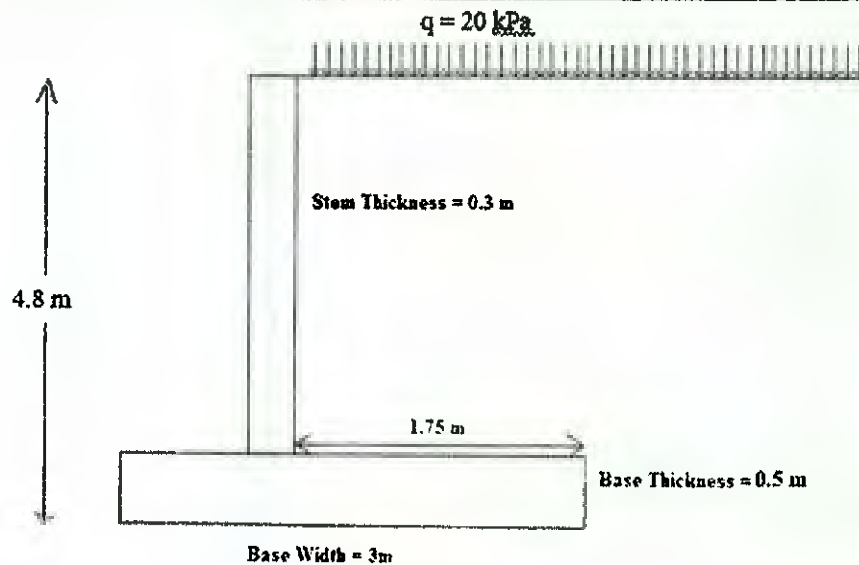


Figure 1

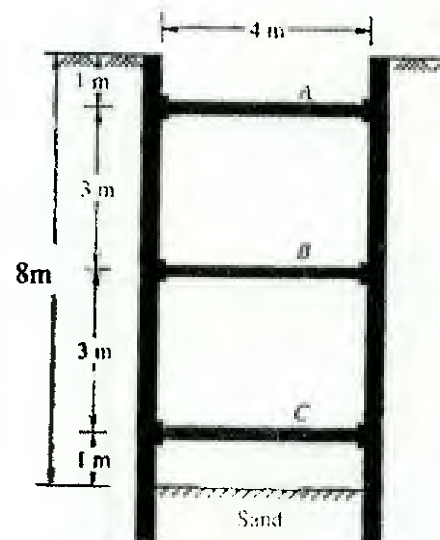


Figure 2



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A

END SEMESTER May 2026 / RE-EXAM July 2026

Equations:

$$N_q = e^{\pi \tan \phi} \tan^2(45 + \phi/2)$$

$$N_c = (N_q - 1) \cot \phi$$

$$N_\gamma = 2(N_q + 1) \tan \phi$$

**END SEM / RE-EXAM EXAMINATION MAY / JUN 2026**Program: Third Year B. Tech Civil Engineering

Duration: 3 Hrs.

Course Code: PC-BTC604

Maximum Points: 100

Course Name: Design of RCC ElementsSem - VISemester: VI**Instructions for the Students:**

02/06/26

1. Attempt any 05 (FIVE) questions
2. Assume suitable data if necessary and state it clearly.
3. Illustrate your answers with neat sketches wherever required.
4. Use of IS 456: 2000 is permitted.

Q. No.	Questions	Points	CO	BL	Module No.
1 a	i. Determine the design constants for M20 Concrete and Fe 415 steel in Working stress method	05	1	3	1
	ii. Explain different types of limit states as per IS 456:2000	05	1	3	3
1 b	A RCC beam is simply supported over a span of 5 m and has a cross section of 300 mm X 600 mm. the beam is reinforced with 4 bars of 20 mm diameter on tension side. If the grade of concrete is M30 and grade of the steel is Fe-415, determine the maximum superimposed uniformly distributed load the beam can carry over the entire span. Use Working Stress Method.	10	2	3	2
2 a	A RCC beam is simply supported over a span of 6 m and carries a superimposed uniformly distributed load of 35 kN/m over the entire span. The cross section of the beam is 300 mm X 600 mm. If the grade of concrete is M30 and grade of the steel is Fe-415, determine the area of compression steel and tension steel required assuming a balanced doubly reinforced section. Use Working Stress Method.	10	2	4	2
2 b	A RCC beam is simply supported over a span of 8 m and carries a superimposed uniformly distributed load of 20 kN/m over the entire span. The cross section of the beam is 300 mm X 600 mm. If the grade of concrete is M30 and grade of the steel is Fe-415, determine the area of tension steel required. Use Limit State Method.	10	2	4	4



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END SEM / RE-EXAM EXAMINATION MAY / JUN 2026

3 a	A RCC beam is simply supported over a span of 8 m and has a cross section of 300 mm X 600 mm. The beam is reinforced with 4 bars of 20 mm diameter on tension side and 3 bars of 20 mm diameter on compression side. If the grade of concrete is M30 and grade of the steel is Fe-415, determine the maximum superimposed uniformly distributed load the beam can carry over the entire span. Use Limit State Method .	10	2	3	4
3 b	A T beam has following properties: Width of Flange = 1800 mm; Depth of Flange = 120 mm; Width of Web = 300 mm; Effective depth = 550 mm. The beam is reinforced with 6 bars of 25 mm diameter in two layers on tension side. If the grade of concrete is M30 and grade of the steel is Fe-415, determine the moment carrying capacity of the beam. Use Limit State Method .	10	2	3	4
4 a	A simply supported beam of span 8 m carries a superimposed uniformly distributed load of 40 kN/m over the entire span. The beam has a cross section of 300 mm X 600 mm and is reinforced with 5 bars of 25 mm diameter on tension side. The width of support is 230 mm. Design shear reinforcement using vertical stirrups considering the grade of concrete as M30 and grade of the steel as Fe-415. Use Limit State Method .	10	2	4	4
4 b	A beam has a cross section of 300 X 600 mm and is subjected to a factored bending moment of 120 kN-m, factored torsional moment of 40 kN-m and a factored shear force of 100 kN. If the grade of concrete is M30 and grade of the steel is Fe-415, determine the area of steel required and the shear reinforcement required in the form of vertical stirrups only. Use Limit State Method .	10	2	4	4
5 a	A RCC Column has unsupported length of 3 m and both ends of the column are effectively held in position and restrained against rotations. A column is subjected to a factored axial load of 2500 kN. Design a short axially loaded column if concrete grade is M30 and steel grade is Fe-415. Use Limit State Method .	10	3	4	6

**END SEM / RE-EXAM EXAMINATION MAY / JUN 2026**

5 b	A RCC Column has a dimension of 375 mm X 900 mm. it is reinforced with 12 bars of 25 mm diameter as main reinforcement. The Column has unsupported length of 3 m and both ends of the column are effectively held in position and restrained against rotations. Determine the maximum load resisted by the column at an eccentricity of 120 mm about minor axis if concrete grade is M30 and steel grade is Fe-415. Use Limit State Method.	10	3	4	6
6	A slab is to be designed over a room size of 3.2 m X 5.6 m, measured internally. The slab is resting on 230 mm thick brick walls on all 4 sides. Live load on the slab is expected as 3 kN/m ² and floor finish load as 1 kN/m ² . The grade of concrete is M30 and grade of steel is Fe-415. Design the slab and sketch the reinforcement details. Use Limit State Method.	20	3	5	5
7	A column has a dimension of 400 mm X 1000 mm and carries an axial compressive load of 1800 kN at service stage. Design an isolated sloped footing for the column if safe bearing capacity of soil is 300 kN/m ² . Assume the grade of concrete as M30 and grade of the steel as Fe-415. Use Limit State Method.	20	4	5	7

Chart 31 COMPRESSION WITH BENDING — Rectangular
Section — Reinforcement Distributed Equally on Two Sides

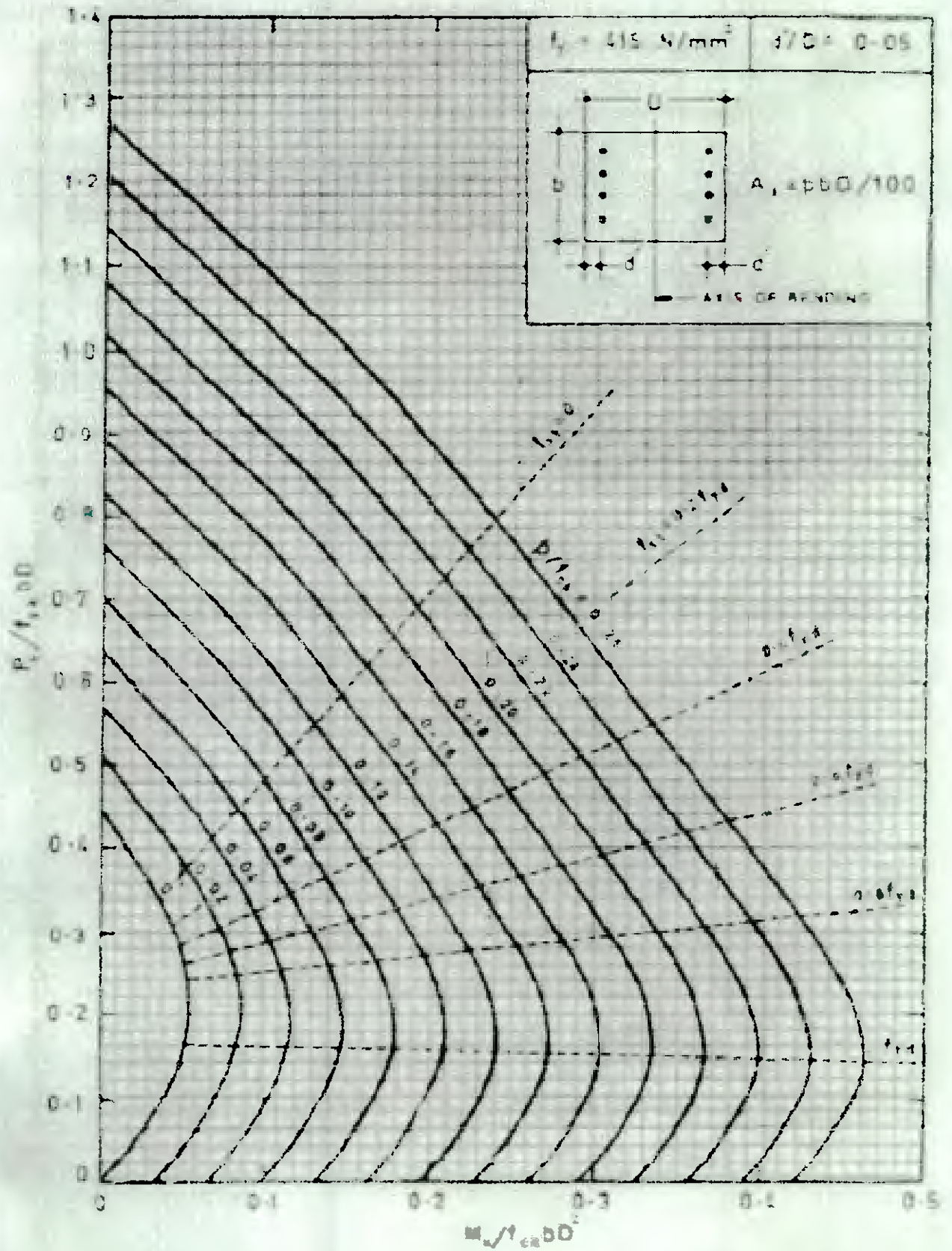


Chart 32 COMPRESSION WITH BENDING — Rectangular
Section — Reinforcement Distributed Equally on Two Sides

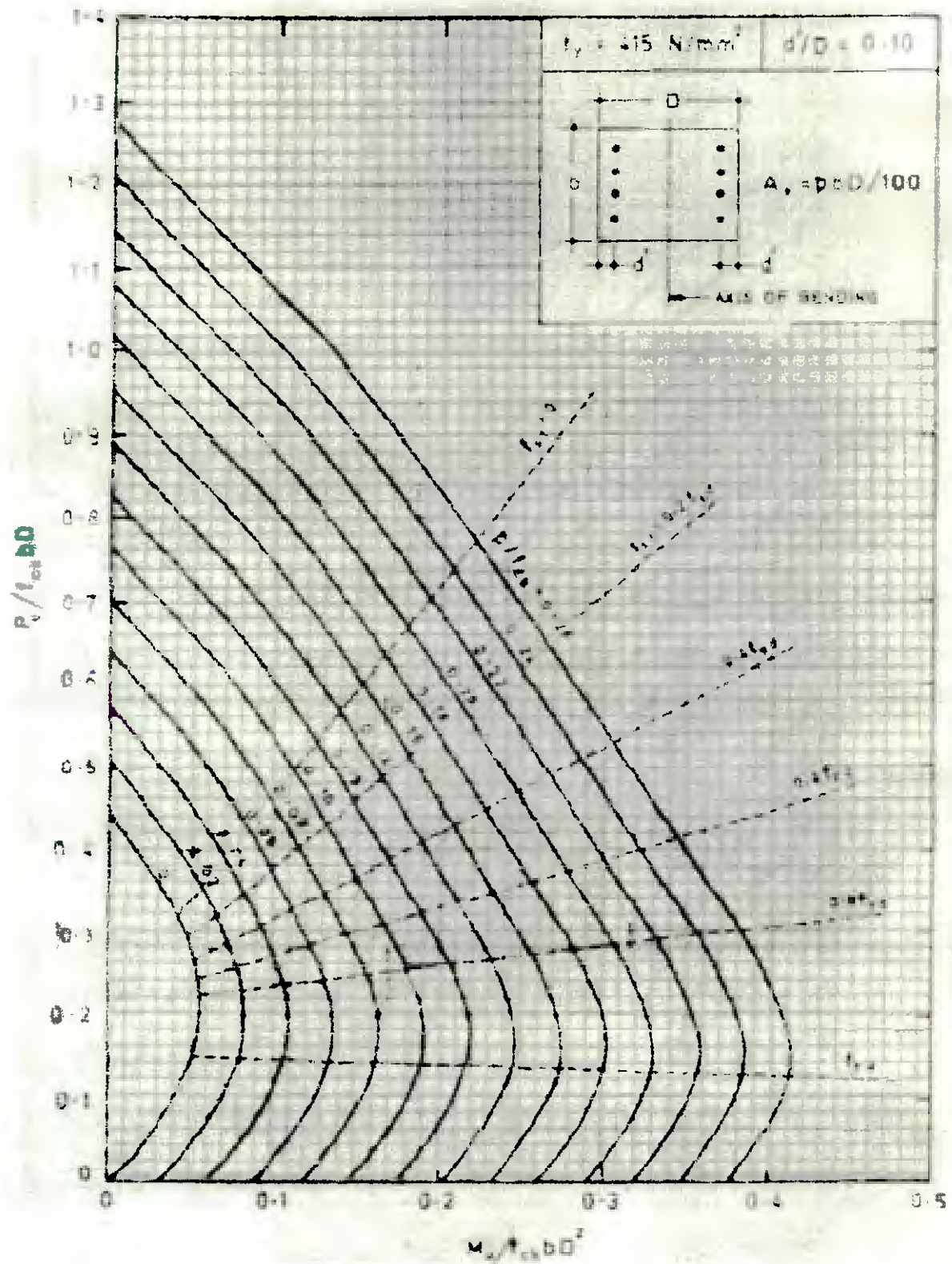


Chart 33 COMPRESSION WITH BENDING — Rectangular
Section — Reinforcement Distributed Equally on Two Sides

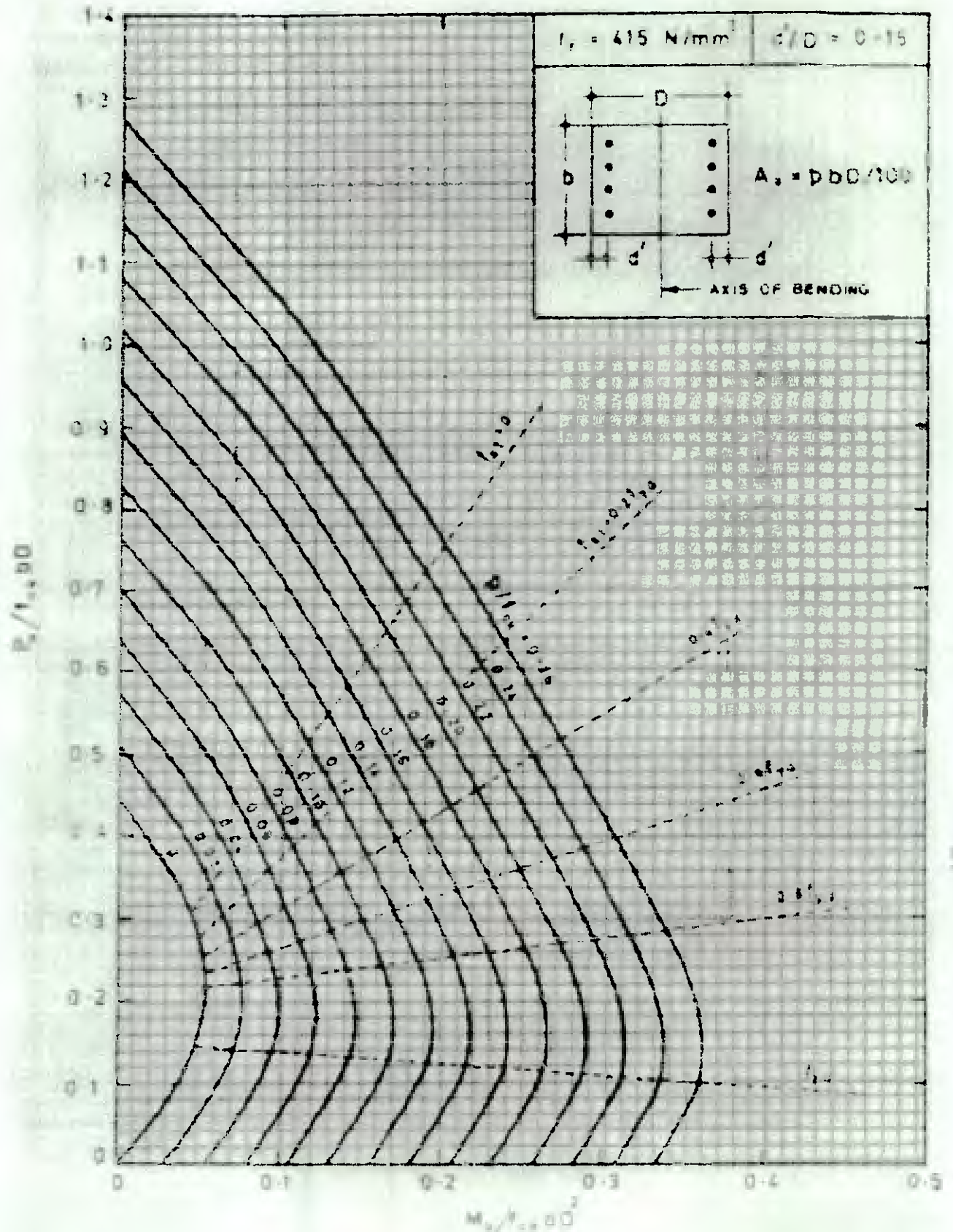
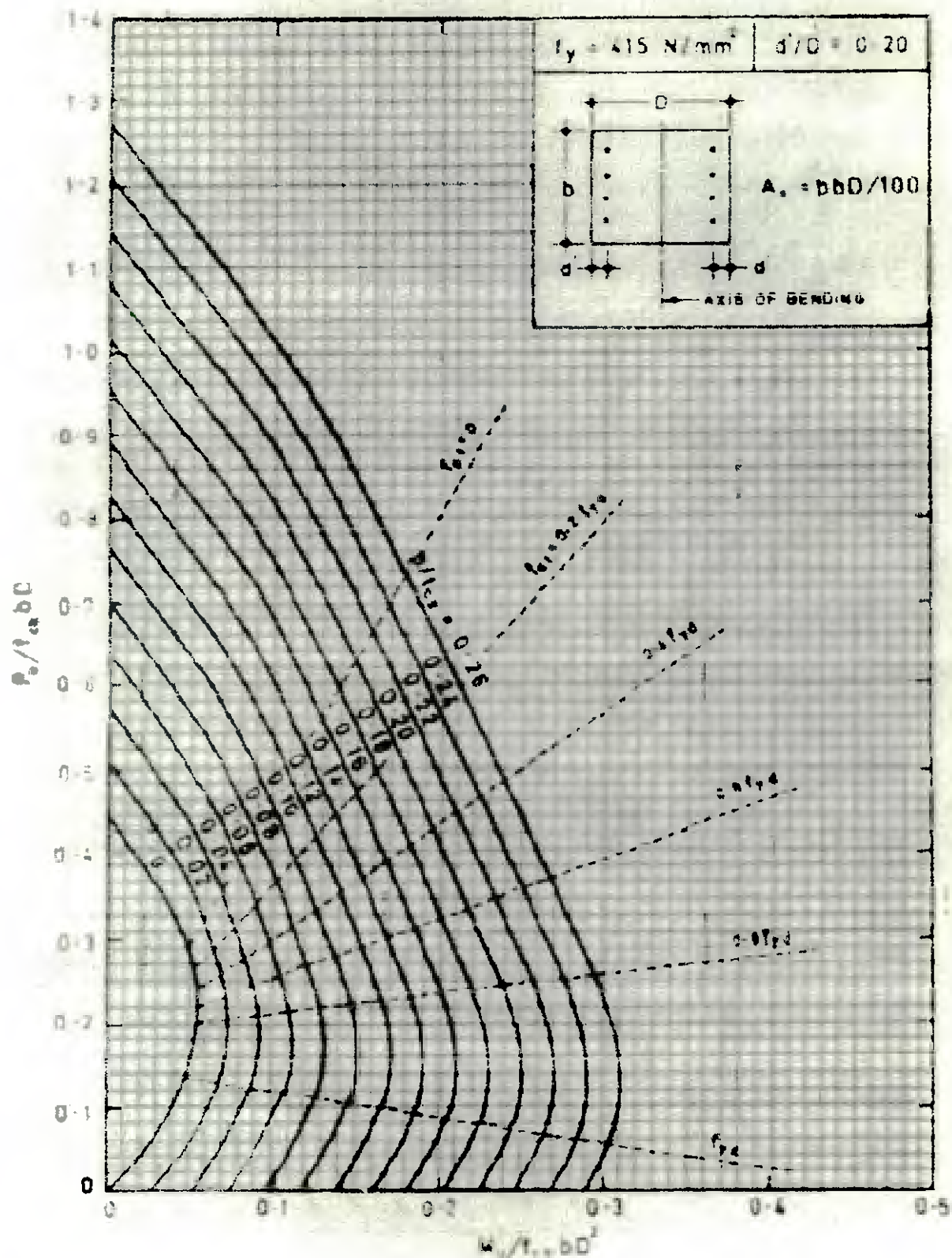


Chart 34 COMPRESSION WITH BENDING — Rectangular Section — Reinforcement Distributed Equally on Two Sides



ϵ_{sc}	f_{sc}	
	Fe-415	Fe-500
0	0	0
$0.80 f_{yd}$	0.00144	0.00174
$0.85 f_{yd}$	0.00163	0.00195
$0.90 f_{yd}$	0.00192	0.00226
$0.95 f_{yd}$	0.00241	0.00277
$0.975 f_{yd}$	0.00276	0.00312
$1.0 f_{yd}$	0.00380	0.00417

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**END SEMESTER EXAM MAY JUNE 2026-SET-A**Program: ~~Civil/Mech./Elect.~~ (Minor) **Third Year B.Tech** Duration: 3 hrs.

Course Code: MI-BT033

Civil

Maximum Points: 100

Course Name: Sustainability AssessmentSemester: VI

- Notes: Question 1 is compulsory. Solve any four of remaining six
- Use illustrations wherever required
- Draw neat sketches/diagrams wherever required and give reasoning wherever required
- Assume suitable data if necessary and state them clearly
- Figure on right indicate maximum points for the given question, course outcomes attained, Bloom's Level and Module Number

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Question No.	Questions	Points	CO	BL	MN																																																																
Q1	Answer these 7 questions related to OpenLCA results : Scenario: Comparative Life Cycle Assessment of Coffee Cups A university cafeteria is evaluating two single-use coffee cup options to reduce its environmental footprint. You have been hired to conduct a comparative LCA using OpenLCA. System Description: Functional Unit: Serving 10,000 hot beverages (250 mL each) over one academic year. System Boundary: Cradle-to-grave (raw material extraction → manufacturing → use → end-of-life). Inventory Data Option A: Single-Use Paper Cup (PE-Lined) <table><thead><tr><th>Life Cycle Stage</th><th>Input/Output</th><th>Value</th><th>Unit</th></tr></thead><tbody><tr><td rowspan="2">Raw Materials</td><td>Paperboard</td><td>12.5</td><td>g/cup</td></tr><tr><td>Polyethylene (PE) lining</td><td>4.2</td><td>g/cup</td></tr><tr><td rowspan="3">Manufacturing</td><td>Electricity (grid mix)</td><td>0.018</td><td>kWh/cup</td></tr><tr><td>Natural gas (heating)</td><td>0.0025</td><td>m³/cup</td></tr><tr><td>Process water</td><td>0.15</td><td>L/cup</td></tr><tr><td rowspan="2">Transport</td><td>Truck (factory → cafeteria)</td><td>350</td><td>km</td></tr><tr><td>Payload per shipment</td><td>8,000</td><td>cups</td></tr><tr><td rowspan="2">End-of-Life</td><td>Landfill rate</td><td>95%</td><td>—</td></tr><tr><td>Incineration rate</td><td>5%</td><td>—</td></tr></tbody></table> Option B: Single-Use PLA Cup (Bioplastic) <table><thead><tr><th>Life Cycle Stage</th><th>Input/Output</th><th>Value</th><th>Unit</th></tr></thead><tbody><tr><td>Raw Materials</td><td>Polylactic acid (PLA)</td><td>9.8</td><td>g/cup</td></tr><tr><td rowspan="2">Manufacturing</td><td>Electricity (grid mix)</td><td>0.022</td><td>kWh/cup</td></tr><tr><td>Process water</td><td>0.08</td><td>L/cup</td></tr><tr><td rowspan="2">Transport</td><td>Truck (factory → cafeteria)</td><td>520</td><td>km</td></tr><tr><td>Payload per shipment</td><td>10,000</td><td>cups</td></tr><tr><td rowspan="2">End-of-Life</td><td>Industrial composting rate</td><td>30%</td><td>—</td></tr><tr><td>Landfill rate</td><td>70%</td><td>—</td></tr></tbody></table>	Life Cycle Stage	Input/Output	Value	Unit	Raw Materials	Paperboard	12.5	g/cup	Polyethylene (PE) lining	4.2	g/cup	Manufacturing	Electricity (grid mix)	0.018	kWh/cup	Natural gas (heating)	0.0025	m³/cup	Process water	0.15	L/cup	Transport	Truck (factory → cafeteria)	350	km	Payload per shipment	8,000	cups	End-of-Life	Landfill rate	95%	—	Incineration rate	5%	—	Life Cycle Stage	Input/Output	Value	Unit	Raw Materials	Polylactic acid (PLA)	9.8	g/cup	Manufacturing	Electricity (grid mix)	0.022	kWh/cup	Process water	0.08	L/cup	Transport	Truck (factory → cafeteria)	520	km	Payload per shipment	10,000	cups	End-of-Life	Industrial composting rate	30%	—	Landfill rate	70%	—	20	2	4,5	2,5
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Background Data (Use ELCD or Ecoinvent equivalents)

Process	Dataset Proxy
Paperboard production	Kraft paper, bleached, at plant
PE granulate	Polyethylene, LDPE, granulate
PLA granulate	Poly lactide, granulate, at plant
Electricity	Electricity, medium voltage, national grid
Truck transport	Transport, freight, lorry 16–32 t, EURO5
Landfill (paper)	Disposal, paper, to sanitary landfill
Landfill (PLA)	Disposal, bioplastic, to sanitary landfill
Incineration	Disposal, municipal solid waste, to incineration
Industrial composting	Treatment, biowaste, composting

Impact Assessment Method

Use CML-IA baseline with the following impact categories:

1. Global Warming Potential (GWP 100a) — kg CO₂-eq
2. Acidification Potential (AP) — kg SO₂-eq
3. Eutrophication Potential (EP) — kg PO₄-eq
4. Abiotic Depletion (fossil fuels) — MJ

Questions: Part A: Model Setup and Inventory (6 Points)

1. Define a product system in OpenLCA for Option A (Paper Cup). List the flows you would create and explain how you would link the foreground processes (cup manufacturing, transport, end-of-life) to background datasets. (2 points)
2. The PLA cup claims "compostable" status, but only 30% actually reaches industrial composting. Explain how you would model this split end-of-life scenario in OpenLCA, including the use of allocation or multiple output processes if needed. (2 points)
3. Calculate the total mass of materials transported to the cafeteria for each option over the functional unit (10,000 cups). Show your work. (2 points)

Part B: Impact Assessment and Comparison (11 Points)

4. After running LCIA for both product systems, you obtain the following results: (5 points)

Impact Category	Paper Cup (Option A)	PLA Cup (Option B)
GWP (kg CO ₂ -eq)	189.4	162.7
AP (kg SO ₂ -eq)	0.87	0.71
EP (kg PO ₄ -eq)	0.14	0.19
Abiotic Depletion (MJ)	2,415	1,980

Interpret these results. Which option performs better overall, and where does each option show trade-offs? Justify your recommendation.

5. Generate a contribution analysis for GWP in Option A. Identify the hotspots and propose two specific design or supply-chain interventions that the cafeteria or supplier could implement to reduce the GWP of Option A.

**END SEMESTER EXAM MAY JUNE 2026-SET-A**

	The breakdown is: (4 points)					
	Process	Contribution to GWP				
	Paperboard production	52%				
	PE lining production	18%				
	Manufacturing (energy)	12%				
	Transport	6%				
	Landfill emissions	10%				
	Incineration	2%				
	6. Explain how you would use OpenLCA's comparison feature to present these results to a non-technical stakeholder (e.g., cafeteria manager). Describe what visualisation you would generate and one limitation you would communicate. (2 points)					
	7. Sensitivity Analysis Conduct a sensitivity analysis by varying one key parameter: (3 points)					
	• Scenario 1: Increase PLA composting rate from 30% → 60%					
	• Scenario 2: Reduce transport distance of PLA cups by 20%					
	Answer the following:					
	a) Which parameter change is likely to have a greater effect on GWP and why?					
	b) How would you implement this sensitivity analysis in OpenLCA (parameter variation or scenario modelling)?					
	c) What does this tell you about the robustness of your LCA conclusions?					
Q2a	What is MFA? Explain its key principle. Discuss the advantages of conducting an MFA.		5	1	2,3	1
Q2b	Explain the following terms: Characterization factor Anthropogenic process in MFA Industrial Ecology Midpoint indicators LCA hotspot		5	1, 2	2	1, 2
Q2c	An electrical engineering firm is conducting an S-LCA for installing 500 kW of rooftop solar panels on a Tier-2 Indian city's government buildings. The solar panels are imported from a Chinese manufacturer whose supply chain includes silicon mining in Xinjiang. a) Define the Goal & Scope for this S-LCA. State the functional unit, system boundaries (from raw material to end-of-life), and geographic scope. (3 points) b) Identify THREE social hotspots in this supply chain and suggest measurable indicators (quantitative or binary) for each. (3 points) c) Compare Environmental LCA (ISO 14040) and Social LCA on any THREE dimensions relevant to this solar project in detail. (4 points)		10	3,4	4	3,5
Q3a	What is sustainability assessment? Discuss its benefits and significance in an engineering design firm.		5	4	2,3	4



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Q3b	Explain with neat sketches how a linear product cycle is different from a circular product cycle for the textile industry. Discuss which is preferred from the perspective of sustainability	5	1,4	3,4	2												
Q3c	Infosys became India's first large IT company to achieve carbon neutrality in FY2020. The following data is available from their sustainability disclosures: <table><tr><th>FY</th><th>Scope 1+2 Intensity (tCO₂e/employee)</th><th>Employees</th></tr><tr><td>FY2018</td><td>1.80</td><td>2,04,107</td></tr><tr><td>FY2021</td><td>0.50</td><td>2,59,619</td></tr><tr><td>FY2023</td><td>0.22</td><td>3,43,234</td></tr></table> a) Calculate absolute Scope 1+2 GHG emissions (in tCO₂e) for FY2018 and FY2023. What is the % reduction in absolute terms? (3 points) b) Under GRI 305 (Emissions), explain the difference between Scope 1, Scope 2, and Scope 3 emissions with ONE example each relevant to an IT company like Infosys. (3 points) c) Infosys claims 'Carbon Neutrality since FY2020' but critics argue this ≠ Net Zero. Using the GRI framework and the concept of carbon offsets vs. actual emission reduction, evaluate this claim. (2 points) d) Map Infosys' achievements to at least TWO GRI 300-series standards and ONE BRSR Section C Principle. Explain why BRSR compliance is mandatory for Infosys. (2 points)	FY	Scope 1+2 Intensity (tCO ₂ e/employee)	Employees	FY2018	1.80	2,04,107	FY2021	0.50	2,59,619	FY2023	0.22	3,43,234	10	3,4	4	4,5
FY	Scope 1+2 Intensity (tCO ₂ e/employee)	Employees															
FY2018	1.80	2,04,107															
FY2021	0.50	2,59,619															
FY2023	0.22	3,43,234															
Q4a	Mumbai Railway Vikas Corporation (MRVC) Ltd. is planning expansion by construction an additional railway line between Virar-Vasai-Panvel. The route passes through a mix of residential, commercial zones, agricultural land, and crosses two small seasonal creeks. MRVC has hired you as a consultant to conduct the initial Environmental Impact Assessment (EIA). Discuss whether to use Ad Hoc method or Checklist method for the EIA. Justify your reasons.	5	1,4	3,4	2,5												
Q4b	Explain the fundamental principles of sustainability reporting as prescribed by the Global Reporting Initiative (such as materiality, stakeholder inclusiveness, sustainability context, completeness, accuracy, balance, clarity, comparability, timeliness, and verifiability) and briefly describe the key features and purpose of the Business Responsibility and Sustainability Reporting (BRSR) framework mandated by Securities and Exchange Board of India.	5	4	3	4												
Q4c	What is urban metabolism? (2 points) Discuss with an example, how MFA can be used in urban metabolism to "create loop closing industrial practices" and to "balance natural ecosystem capacity" (4 points each)	10	1	2,3	1												
Q5a	A factory produces aluminium engine mounting brackets from solid billets. The process uses a cutting fluid (coolant) to manage heat and	5	1,4	3,4	1,5												

**END SEMESTER EXAM MAY JUNE 2026-SET-A**

	friction. 50 raw aluminium billets of 12 kg each are fed into the machine, which produces 50 finished engine brackets weighing 8.5 kg each. 168 kg of aluminium chips (by-product) are collected in a hopper to be sold to a recycler. The process required 25 kg of fresh cutting liquid of which 16.5 kg is collected from the bottom of the machine into a hazardous waste barrel in heavily degraded form. Draw a simple system boundary diagram showing all inputs and outputs for both the aluminium and the cutting fluid. Calculate the stock for both aluminium and cutting fluid. Calculate and comment on the material efficiency of aluminium (% of raw aluminium which gets converted to final product).																			
Q5b	As per ISO14040, draw the basic framework of LCA. Discuss why it is inherently relative and how it may be used for product development and improvement.	5	2,4	3,4	2															
Q5c	A state PWD is evaluating two pavement alternatives for a 12 km urban road. Analysis period: 25 years. Discount rate: 9%. <table><tr><th>Cost Element</th><th>Option A: Bituminous (Flexible)</th><th>Option B: Cement Concrete (Rigid)</th></tr><tr><td>Capital Cost (Year 0)</td><td>₹16 crore</td><td>₹24 crore</td></tr><tr><td>Annual O&M (Years 1–25)</td><td>₹55 lakh/yr</td><td>₹15 lakh/yr</td></tr><tr><td>Resurfacing (at Year 12)</td><td>₹4.5 crore</td><td>None</td></tr><tr><td>Salvage Value (Year 25)</td><td>₹0.60 crore</td><td>₹2.0 crore</td></tr></table> a) Compute the Life Cycle Cost (LCC) for both options step by step. (6 points) b) The government is considering adding an environmental cost of ₹12 lakh/year for air quality deterioration from construction dust for bituminous Option A. Using an environmental discount rate of 3%, recalculate the E-LCC of Option A. (2 points) c) Explain how the choice of discount rate (3% vs. 9%) systematically biases a long-term infrastructure decision. (2 points)	Cost Element	Option A: Bituminous (Flexible)	Option B: Cement Concrete (Rigid)	Capital Cost (Year 0)	₹16 crore	₹24 crore	Annual O&M (Years 1–25)	₹55 lakh/yr	₹15 lakh/yr	Resurfacing (at Year 12)	₹4.5 crore	None	Salvage Value (Year 25)	₹0.60 crore	₹2.0 crore	10	3	4	3,5
Cost Element	Option A: Bituminous (Flexible)	Option B: Cement Concrete (Rigid)																		
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Resurfacing (at Year 12)	₹4.5 crore	None																		
Salvage Value (Year 25)	₹0.60 crore	₹2.0 crore																		
Q6a	What is validation in inventory analysis phase of LCA? Discuss its importance and consequences of not carrying out validation	5	2	2,3	2															
Q6b	A Waste Electrical and Electronic Equipment (WEEE) recycling plant processes 2000 kg of shredded motor scrap per day. Based on lab sampling, this specific batch of scrap is exactly 12% Copper by mass. The process splits the shredded material into three output streams. The transfer coefficients for Copper to these streams are as follows: Stream 1 (High-Purity Non-Ferrous): 0.82, Stream 2 (Ferrous/Magnetic Scrap): 0.06, Stream 3 (Dust & Shredder Residue): Unknown Determine the transfer coefficient of Copper to Stream 3 (1 point) Calculate the actual mass of Copper (in kg) that physically ends up in Stream 1 and Stream 3 each day. (2 points) Comment on Stream 3 results from environmental and economic	5	1,4	3,4	1,5															



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END SEMESTER EXAM MAY JUNE 2026-SET-A

	perspective if cost of copper is Rs. 1,250/- per kg. (2 points)				
Q6c	A 6th-semester student is assigned to develop a sustainability scorecard for a mid-sized Indian cement company that has high GHG emissions, significant water consumption from limestone mining, a workforce that is 75% male, no formal grievance mechanism for workers, and no third-party audit of its sustainability report. Using the materiality assessment process as per Global Reporting Initiative (GRI 3), identify four material topics, selecting one each from Environmental, Social, Governance, and Economic dimensions (4 points). For each material topic identified, suggest one quantitative KPI from relevant GRI 300 or 400 series standards, clearly stating the indicator and its unit of measurement (4 points) Further, explain why Securities and Exchange Board of India requires the Business Responsibility and Sustainability Report (BRSR) to be signed off by the Board of Directors, and how this requirement improves the credibility of sustainability disclosures compared to voluntary reporting (2 points)	10	4	4	4,5
Q7a	What is EIA and how does it help in sustainability assessment? Explain the various steps carried out in Phase I and the conditions under which Phase II EIA is conducted.	10	1	3	1,2
Q7b	On 24 April 2013, the Rana Plaza building in Dhaka, Bangladesh collapsed, killing over 1,100 garment workers. Workers had reported cracks in the building the previous day but were forced to return. The factories supplied garments to major European and American brands. Wages were approximately \$38/month with 12-16 hour shifts and virtually no union representation. a) Identify the FOUR phases of S-LCA methodology and apply each phase to a garment supply chain for a global fashion brand. (4 points) b) Under the S-LCA stakeholder category of 'Workers', list FOUR social indicators that were clearly violated at Rana Plaza, with specific evidence from the case. (3 points) c) As an engineer designing an automated stitching system for Bangladesh garment factories, how does S-LCA guide your design decisions regarding worker displacement and safety? (3 points)	10	3-4	4	3,5



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End Semester 2026 Examinations



Program: ~~C~~ Third Year B. Tech Civil
Course Code: MI BT 013
Course Name: Financial Management Sem VI

Duration: **03 hours**
Maximum Points: **100**
Semester: **VI**

Note:

- Question 01 is compulsory
- Attempt any four questions out of remaining 06 questions
- Attempt main question and sub question together
- Draw neat charts wherever required
- Q5 B, 6 and & 7 to be attempted on Excel sheet.

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Sr No	Questions	Module	BL	Points
Q 1.A	Critically analyse the difference between profit maximization and wealth maximization as objectives of financial management.	01	L2	10
Q.1.B	Examine the role of ethics in financial management. How do ethical principles contribute to transparency, accountability, and stakeholder trust? Illustrate your answer with suitable examples of ethical and unethical financial practices.	07	L4	10
Q.2.A	Discuss in detail the scope and importance of financial management in modern organizations. Explain the major functions of financial management.	02	L2	10
Q.2.B	Name three types of capital budgeting and explain in detail the function and scope of capital budgeting.	03	L1	10
Q.3. A	Explain various approaches to the measurement of risk in financial management.	03	L5	20 10
Q.3.B	What do you understand by risk and return? Explain its components and the way it is measured with suitable example.	04	L4	10
Q.4.A	Explain briefly the concept of Time Value of Money and the genesis behind this concept.	02	L2	10
Q.4.B	ABC Ltd. is focusing on increasing profits by cutting costs drastically, including reducing product quality and employee training. In the short term, profits increase significantly, but			

Customer satisfaction declines.

Questions

1. Explain how this decision reflects the profit maximization approach.
2. Analyse why wealth maximization would be a better objective.
3. Suggest financial strategies to balance profitability and long-term value.

	Customer satisfaction declines.																					
	Questions 1. Explain how this decision reflects the profit maximization approach. 2. Analyse why wealth maximization would be a better objective. 3. Suggest financial strategies to balance profitability and long-term value.																					
Q.5. A	Identify how financial management contributes to long-term sustainability of organizations. Explain how financial strategies influence business expansion decisions.	04	L5	10																		
Q.5 B	Mr. Soham is an entrepreneur with a business in Medical Equipment space. He has received a large order from a US company for which he needs to incur a capex of INR 5 CR. He currently plans to fund the capex through a bank loan which is available at 9% pa for a 5-year loan. Please calculate the EMI and share the principal outstanding at the end of 15 th monthly repayment? (5+5)	03	L5	10																		
Q.6.A.	Nishant is a final year graduating student currently interning at a startup. Out of his monthly stipend he invests INR 5000/- every month. He plans to invest this for the next 12 months and expects a return of 12%pa. What would be his corpus at the end of 2 years?	03	L3	10 20																		
Q.7.A	2. Please calculate the Payback period for the below mentioned projects: (10 Marks) Initial Investment in Project A is 11,00,000/- and Project B 12,50,000/-. <table><tr><th>Year</th><th>Project A Cash Flow</th><th>Project B Cash Flow</th></tr><tr><td>1</td><td>1,00,000/-</td><td>2,25,000/-</td></tr><tr><td>2</td><td>2,50,000/-</td><td>1,00,000/-</td></tr><tr><td>3</td><td>1,00,000/-</td><td>2,00,000/-</td></tr><tr><td>4</td><td>4,50,000/-</td><td>3,25,000/-</td></tr><tr><td>5</td><td>5,00,000/-</td><td>4,00,000/-</td></tr></table> Please calculate the payback period for both the projects.	Year	Project A Cash Flow	Project B Cash Flow	1	1,00,000/-	2,25,000/-	2	2,50,000/-	1,00,000/-	3	1,00,000/-	2,00,000/-	4	4,50,000/-	3,25,000/-	5	5,00,000/-	4,00,000/-	04	L6	10
Year	Project A Cash Flow	Project B Cash Flow																				
1	1,00,000/-	2,25,000/-																				
2	2,50,000/-	1,00,000/-																				
3	1,00,000/-	2,00,000/-																				
4	4,50,000/-	3,25,000/-																				
5	5,00,000/-	4,00,000/-																				

Q.7.B	Mrs.Sheya is an entrepreneur with a business in Medical Equipment space. He has received a large order from a US company for which he needs to incur a capex of INR 7 CR. He currently plans to fund the capex through a bank loan which is available at 11% p.a for a 3-year loan. Please calculate the EMI and share the principal outstanding at the end of 9 th monthly repayment? (5 + 5 Marks)	06	L6	10
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**END SEMESTER/RE-EXAMINATION: MAY/JUNE 2026***Third Year**Sem-VI***Program: B.Tech. in Civil Engineering****Duration: 3 Hours****Course Code: PE-BTC621****Maximum Points: 100****Course Name: Analysis of Indeterminate Structures****Semester: VI**

1. Attempt any FIVE questions out of SEVEN questions.
2. Answers to all sub questions should be grouped together.
3. Figures to the right indicate full marks.
4. Assume suitable data if necessary and state the same clearly.

04/06/26

Q.No	Questions	Points	CO	BL	Module
Q1(a)	Using flexibility method, find the horizontal reaction at D for the rigid jointed frame loaded as shown in figure below.	12	1	3,4	1
Q1(b)	Find the horizontal reaction at D for the truss loaded as shown in figure below by flexibility method. Assume AE to be same for all the members.	08	1	3,4	1
Q2(a)	Analyse the continuous beam shown in figure using three moment theorem and find the support moments.	10	1	4	2



Q2(b)	A two hinged parabolic arch of span 36 m and rise 6 m carries a concentrated load of 20 kN at 8m from the left support and another concentrated load of 30 kN at 26m from the left support. Determine the horizontal thrust in the arch. The moment of inertia (MI) of the section of the arch varies as $I = I_0 \sec\theta$, where I_0 = MI of the section at the crown.	10	1	3,4	2
Q3(a)	Using the theorem of least work, find the reactions at B and C for the continuous beam loaded as shown in figure below.	14	1	3,4	3
Q3(b)	Write down different methods of analysis that you have studied under force method and displacement method.	06	1	3,4	1
Q4(a)	Using slope deflection method, find the unknown displacements and end moments for the frame loaded as shown in the figure below.	14	2	3,4	4
Q4(b)	Calculate the stiffness coefficients and write the stiffness matrix for the beam shown in figure w.r. to the coordinates indicated in the figure.	06	2	3	6



Q5	Analyse the rigid jointed frame loaded as shown in the figure below by moment distribution method and find the end moments.	20	2	3,4	5
Q6(a)	Using stiffness method, find the unknown displacements in the rigid jointed frame loaded as shown in the figure below.	17	2	3,4	6
Q6(b)	State lower bound theorem.	03	1,2	1,2	7
Q7(a)	Find the shape factor of an unsymmetrical I section with following details: Top flange width = 240 mm & thickness = 15 mm Bottom flange width = 180 mm & thickness = 10 mm Depth of web = 460 mm and thickness of web = 10 mm	10	3	3,4	7
Q7(b)	A continuous beam is subjected to working loads as shown in figure below. If $M_p = 70$ kN-m, calculate the (true) load factor for the beam.	12	3	3,4	7

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**TERM END/ RE EXAM MAY- JUNE 2026**Program: Third Year B. tech Civil

Duration: 3 Hrs

Course Code: PE-BTC 623Sem-VI

Maximum Points:100

Course Name: Repair and rehabilitation of StructuresSemester: VI

NOTE: Solve any 5 questions

4/6/26

Q. No.	Questions	Points	CO	Module No.
1(a)	Explain in detail how deterioration of cementitious system takes place.	10	CO1	2
1(b)	What is the objective of maintenance? What are the factors affecting maintenance?	10	CO1	1
2(a)	Write a note on mechanical, chemical and physical causes of deterioration of structures	10	CO1	2
2(b)	Name different non- destructive and destructive techniques of concrete testing. Explain in detail how half cell potential method is performed and how the test results are interpreted	10	CO3	4
3(a)	Explain the method of impressed current cathodic protection for corrosion affected structure	08	CO4	7
3(b)	Explain how chloride extraction is performed in detail. Under which circumstances it is carried out and also for which RC member.	12	CO4	7
4(a)	What are the criterion for selection of repair material for repair project	08	CO4	5

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**TERM END/ RE EXAM MAY- JUNE 2026**

4(b)	Explain in detail with sketches retrofitting of beam using FRP . What are advantages of beam strengthening using FRP.	12	CO4	6
5(a)	Describe need for re alkalization of concrete members and how the procedure is carried out	12	CO4	7
5(b)	Explain need for condition assessment and non-destructive testing of concrete and how it is performed.	08	CO3	4
6(a)	What are different methods of retrofitting columns? Explain in detail the process of retrofitting columns with jacketing. Draw proper sketches	08	CO4	6
6(b)	Explain probable causes of Different types of cracks formed on slab beam and column with proper sketches and their probable causes	12	CO2	3
7(a)	Explain Process of corrosion of reinforcement with chemical reaction at different stages of corrosion.	10	CO2	2
7(b)	Explain in detail electrochemical repair for corrosion using cathodic protection with proper diagrams	10	CO4	7



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END SEMESTER EXAMINATION MAY/JUNE 2026

Program: CIVIL ENGINEERING *Third Year B.tech* Duration: 3 hrs

Course Code: PE-BTC641

Civil

Sem - VI

Maximum Points: 100

Course Name: Solid and Hazardous Waste Management

Semester: VI

Notes: Q.1 is compulsory and attempt any four out of remaining six questions

04/06/26

Q. No.	Questions	Points	CO	BL	Module No.
1	Solve any Four: A. Types of solid wastes. B. Discuss the effects of hazardous waste on the environment. C. Make a list of any five ideal site selection requirements for a landfill. D. Incineration & its objectives. E. Process of Paper recycling. F. Onsite disposal of solid waste.	20	1-4	I,II	1-7
2	A. Define: Solid waste & solid waste management. Discuss the key issues in solid waste management along with its effect on environment. B. Discuss any five causes of generation of solid waste. C. Write a short note on : Primary collection of solid waste	10+5+5	1-4	I,III	2,3
3	A. Discuss the various unit operations carried out at the processing station in solid waste management. B. Discuss the various advantages of a transfer station in solid waste management. C. Solid waste from a new industrial area is to be collected in large containers, some of which will be used in conjunction with stationary compactors. Based on traffic at similar parks, it is estimated that the average time to drive from the garage to the first container and from the last container to garage each day will be 16 and 22 min, respectively. If the average time required to drive between containers is 6 min (dbc) and the one way distance to the disposal site is 15.5 mi/h for which speed limit is 55 mi/h (88.5 km/h). Assume 8-hour workday, $S=0.133$; $a=0.016$; $b=0.018$; Assume off route factor (W) as 0.15. ($pc+uc - 0.4$ hour/trip) ➤ Determine the pickup time per trip (in hrs/trip) ➤ Determine the time per trip (in hrs/trip) ➤ Determine the number of trip that can be made per day (in trip/day) ➤ Determine the actual length of the work day(in hours)	10+5+5	1-4	I,II	3,4

**END SEMESTER EXAMINATION MAY/JUNE 2026**

4	A. What do you mean by Transportation of solid waste? Discuss the various types of modes available for transportation of solid waste. B. Discuss the various types of Material Recovery Facility. C. One kilogram of solid waste has the following chemical composition by weight: • Carbon (C) = 30% • Hydrogen (H) = 4.3% • Sulphur (S) = 0.2% • Nitrogen (N) = 1% • Oxygen (O) = 24% • Chlorine (Cl) = 0.5% • Moisture (H₂O) = 20% • Ash = 20% Estimate the Higher Heating Value (HHV) and Lower Heating Value (LHV) of the waste.	10+5+5	1-4	I,II	3,4
5	A. What do you mean by composting? Discuss the various phases composting process. B. Define: Anaerobic Digestion of waste. Discuss the stages of anaerobic digestion of solid waste. C. Compare the Indore method and Bangalore method of composting.	10+5+5	1-4	II	4
6	A. Define landfill. Discuss the various landfill methods used for the disposal of solid waste. B. Define: Leachate. Write a short note on: Treatment on leachate. C. Estimate the desired landfill area for a community with population of 40000 assuming the solid waste generation rate is 2.9 kg/capita/day and specific weight of solid waste is 440kg/m³. Average depth for compacted solid waste is 6.0 m.	10+5+5	1-4	II	4,5
7	A. What do you mean by hazardous waste? Discuss any two characteristics of hazardous waste materials as per Hazardous and other waste (Management & Trans boundary movement) Rules, 2016. B. Discuss any five major sources of hazardous waste generation with suitable examples. C. Make a list of CHWTSDF in hazardous waste management.	10+5+5	1-3	II	6,7



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END SEM Examinations May/ June 2026 (Set-2)

Program: Civil Engineering Third Year B.tech **Duration:** 3hr

Course Code: PE-BTC644 Civil Sem-VI **Maximum Points:** 100

Course Name TQM and MIS in construction

Semester: VI

Instructions:

04/06/26

1. Attempt any five questions.
2. Use A-4 size graph paper to draw control chart
3. Neat diagrams must be drawn wherever necessary.
4. Assume Suitable data if necessary and state it clearly.

Q. No.		Questions	Points	CO	BL	Mod.		
1	a	Explain in detail dimensions of quality.	06	CO1 CO3	2	4		
	b	Differentiate between Preventive action and corrective action in quality management.	06	CO1	1	1		
	c	Describe in detail DMAIC process of six sigma with suitable example.	08	CO2	1	1		
2	a.	What are the advantages of Efficient MIS to an organization?	08	CO1	3	5		
	b	Explain the benefit of work instruction towards quality achievement.	07	CO2	4	6		
	c	Explain in detail the procedure for documentation of quality.	05	CO2	3	3		
3	Following data refers to the Abrasion test of chequered tile used for public footpaths, metro platform corridors, to facilitate high-volume foot traffic safely. QC Managers decided to check variations in the Quality and wish to ensure the stability of process. Analyze the data and comment on the stability of process.							
	a		10	CO2	3	5		
	Abrasion resistance test results							
	Day	Observed loss in thickness in mm results at different time intervals						
		8.00-10.00	10.00-12.00	12.00-14.00	14.00-16.00	16.00-18.00	18.00-20.00	20.00-22.00
	1	2.52	1.89	2.64	1.94	2.27	2.81	2.24
	2	2.3	1.67	2.42	1.72	2.05	2.59	2.02
	3	2.41	1.78	2.53	1.83	2.16	2.7	2.13
	4	2.17	1.54	2.29	1.59	1.92	2.46	1.89
	5	2.25	1.62	2.37	1.67	2	2.54	1.97
6	2.18	1.55	2.3	1.6	1.93	2.47	1.9	
7	2.44	1.81	2.56	1.86	2.19	2.73	2.16	
8	2.31	1.68	2.43	1.73	2.06	2.6	2.03	
9	2.33	1.7	2.45	1.75	2.08	2.62	2.05	
10	2.54	1.91	2.66	1.96	2.29	2.83	2.26	

3	b	What do you understand responsibility matrix as per ISO 9001?	04	CO1	2	4
	c	Discuss advantages of efficient MIS to an organization	06	CO1	3	3
4	a	Discuss various tools and techniques used to control quality.	08	CO2	3	2
	b	Akshay Enterprise manufactures Heavy duty paver blocks for road construction. A Quality inspector randomly draws samples for 20 days and reports the defective paver blocks for each sample size from different production lot. Based on the given data, prepare the control chart for the fraction defective and state whether the process is in statistical control or not.	12	CO1	3	5

Observations sheet of Akshay Enterprise

Lot	Sample size	Number of defective paver blocks	Lot	Sample size	Number of defective paver blocks
1	5000	38	11	5000	33
2	5000	19	12	5000	29
3	5000	26	13	5000	37
4	5000	33	14	5000	39
5	5000	37	15	5000	21
6	5000	24	16	5000	28
7	5000	22	17	5000	37
8	5000	24	18	5000	29
9	5000	26	19	5000	41
10	5000	29	20	5000	32

5	a	Explain in detail the Core Responsibilities of a Certification Body in ISO 9001.					10	CO4	2	4	
	b	Refer the data given below for observing the variation in concrete quality. Perform <u>the median test and up-down test</u> . State whether the process is in control or not. (Consider z-value of ± 2.0 for comparison 95.5 level of acceptance).					10	CO 3	3	5	
		Lot	Avg slump value, mm	Lot	Avg slump value, mm	Lot	Avg slump value, mm	Lot	Avg slump value, mm	Lot	Avg slump value, mm
		1	86	7	88	13	79	19	71	25	69
		2	92	8	78	14	90	20	73	26	77
		3	76	9	67	15	88	21	78	27	73
		4	68	10	73	16	67	22	74	28	67
		5	74	11	74	17	77	23	66	29	69
6	91	12	84	18	74	24	72	30	64		

6	a	Discuss 6 C's for implementation of TQM	08	CO4	1	4
	b	Rubi Industry manufactures stoneware pipes for sewer line construction with production capacity of 1000 units per day. Defects in each lot are recorded during testing. Prepare appropriate control chart and comment on the state of control.	12	CO3	3	5

Observations sheet for stoneware pipes

Lot	No. of defects in the sample	Lot	No. of defects in the sample	Lot	No. of defects in the sample
1	25	11	53	21	48
2	24	12	49	22	44
3	26	13	51	23	46
4	28	14	40	24	57
5	32	15	56	25	54
6	44	16	64	26	42
7	33	17	47	27	48
8	34	18	58	28	46
9	42	19	57	29	54
10	45	20	59	30	45

a.	Discuss the components of quality manual.	06	CO2	2	3
b.	Discuss in brief different types of audit with their suitability.	07	CO 2	1	2
	Determine the Six sigma value of a construction project by referring following table.	07	CO3	3	5

A QC engineer inspected the installation of lifts in 40 Towers comprises of G+30 Storied.

Following defects were observed in the operation of Lifts:

1. Lighting problem was observed in 26 lifts;
2. Electric fan was not working in 13 lifts;
3. Difference in floor level of lift and passage was observed in 9 lifts;
4. Emergency alarm was not working in 14 lifts;
5. Display screen was not working in 18 lifts.

If there are two lifts provided in each tower

Sigma Level	Defects per Million Opportunities	Percentage Yield
1 σ	691,462	31
2 σ	308,537	69
3 σ	66,807	93.3
4 σ	6,210	99.38
5 σ	233	99.977
6 σ	3.4	99.99966

Reference table for Mean and Range Chart

Tabular values for X-bar and range charts				
Subgroup Size	A ₂	d ₂	D ₃	D ₄
2	1.880	1.128	----	3.268
3	1.023	1.693	----	2.574
4	0.729	2.059	----	2.282
5	0.577	2.326	----	2.114
6	0.483	2.534	----	2.004
7	0.419	2.704	0.076	1.924
8	0.373	2.847	0.136	1.864
9	0.337	2.970	0.184	1.816
10	0.308	3.078	0.223	1.777



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END SEM/RE-EXAM EXAMINATION MAY/JULY 2026

Program: Civil Engineering Third Year B.tech Duration: 3 hr.

Course Code: PE-BTC654 Civil Sem-VI Maximum Points: 100

Course Name: Engineering Risk and Uncertainty Semester: VI

Instructions:

1. Question no. 1 is compulsory.
2. Attempt any 4 questions out of remaining 6 questions
3. Neat diagrams must be drawn wherever necessary.
4. Assume Suitable data if necessary and state it clearly

04/06/26

Q. No.	Questions	Points	CO	BL	Mod																								
1	It is proposed to execute a BOT bridge project with investment of ₹900 cr.	20	3	4	3,5 &6																								
	The concession period is 5 years. Annual toll revenue is ₹180 cr., ₹200 cr., ₹220 cr., ₹240 cr., ₹260 cr. from 1 st to 5 th year. Operation and maintenance cost is ₹40 cr., ₹42 cr., ₹44 cr., ₹46 cr., ₹48 cr. from 1st to 5th year. Discount rate is 10%. a) Compare the project based on PV, FV, NPV, and IRR methods. b) Discuss practical interpretation and risk management based on PV, FV, NPV, and IRR. c) Perform and Discuss sensitivity analysis for 8% and 12% discount rate.																												
2a	It is proposed to construct a bridge across the creek in Thane.	10	1&2	3	1,2																								
	Discuss in detail different risks likely to occur over the life cycle of a bridge construction.																												
2b	Prepare a risk register for the construction of a bridge across Thane creek.	10	2&3	2	2,3																								
3a	A contractor is executing a metro station project in Mumbai. The project is scheduled for 180 days with a budget of ₹50 crore.	10	3	3	6																								
	Due to uncertainties (weather, labour strikes, material delays), both time and cost overruns occur with certain probabilities. <table><tr><th>Time Overrun (days)</th><th>Probability</th><th>Cost Overrun (₹ crore)</th><th>Probability</th></tr><tr><td>0</td><td>0.10</td><td>0</td><td>0.15</td></tr><tr><td>10</td><td>0.20</td><td>2</td><td>0.25</td></tr><tr><td>20</td><td>0.30</td><td>4</td><td>0.30</td></tr><tr><td>30</td><td>0.25</td><td>6</td><td>0.20</td></tr><tr><td>40</td><td>0.15</td><td>8</td><td>0.10</td></tr></table> Use the following random numbers (scaled 1–100):					Time Overrun (days)	Probability	Cost Overrun (₹ crore)	Probability	0	0.10	0	0.15	10	0.20	2	0.25	20	0.30	4	0.30	30	0.25	6	0.20	40	0.15	8	0.10
Time Overrun (days)	Probability	Cost Overrun (₹ crore)	Probability																										
0	0.10	0	0.15																										
10	0.20	2	0.25																										
20	0.30	4	0.30																										
30	0.25	6	0.20																										
40	0.15	8	0.10																										

	07, 22, 35, 41, 56, 63, 72, 81, 88, 95, 12, 27, 44, 59, 68																																
	i) Simulate 15 trials of project execution using the random numbers. ii) Compute the average time overrun (days). iii) Compute the average cost overrun (₹ crore).																																
3b	During construction of a flyover over a busy junction, traffic congestion and material supply delays occur. Differentiate between risk and uncertainty in this context. Suggest mitigation measures	10	2 &3	2	1,2 & 3																												
4a	A developer in Mumbai wants to appoint a contractor for High-rise building project	10	3	3	4 &5																												
	Payoff Matrix (Expected profit saving in Crores ₹) under states of nature as S1,S2 and S3																																
	<table><tr><td>Contractor</td><td>(S1) Favorable</td><td>(S2) Moderate</td><td>(S3) Recession/ Difficult Condition</td></tr><tr><td>A</td><td>18</td><td>10</td><td>2</td></tr><tr><td>B</td><td>22</td><td>8</td><td>-4</td></tr><tr><td>C</td><td>15</td><td>12</td><td>6</td></tr></table>					Contractor	(S1) Favorable	(S2) Moderate	(S3) Recession/ Difficult Condition	A	18	10	2	B	22	8	-4	C	15	12	6												
Contractor	(S1) Favorable	(S2) Moderate	(S3) Recession/ Difficult Condition																														
A	18	10	2																														
B	22	8	-4																														
C	15	12	6																														
	State which contractor should the developer choose on the basis of i) Maximin criterion ii) Maximax criterion iii) Equal likely decision (Laplace) criterion iv) Minimax Regret Criterion v) Hurwicz criteria ($\alpha=0.7$)																																
4b	Discuss the role of insurance in the context of risk management.	10	1	2	2																												
5a	A contractor faces challenges of crane operations at height, approval delays from authority, geopolitical crisis and fluctuating cement prices. Identify types of risks (technical, financial, safety) and propose mitigation measures. Discuss it in detail.	10	2	3	1,2 & 3																												
5 b	A contractor in Mumbai must decide how to acquire a tower crane for a high-rise project.	10	3	3	5																												
	Three options are available: 1. New Purchase – High upfront cost, lower maintenance, longer life. 2. Second-Hand Purchase – Lower upfront cost, higher risk of breakdown. 3. Rental Basis – No ownership, flexible, but recurring rental charges. Probabilistic outcomes are estimated as follows:																																
	<table><tr><td>Option</td><td>Cost (Rs. Lakh)</td><td>Prob.</td><td>Monthly Revenue (Rs. Lakh)</td><td>Prob.</td><td>Maintenance/ Breakdown Cost (Rs. Lakh)</td><td>Prob.</td></tr><tr><td>New Purchase</td><td>200</td><td>0.5</td><td>60</td><td>0.6</td><td>10</td><td>0.4</td></tr><tr><td>Second-Hand</td><td>120</td><td>0.3</td><td>50</td><td>0.5</td><td>20</td><td>0.5</td></tr><tr><td>Rental Basis</td><td>40/month</td><td>0.2</td><td>55</td><td>0.7</td><td>5</td><td>0.3</td></tr></table>					Option	Cost (Rs. Lakh)	Prob.	Monthly Revenue (Rs. Lakh)	Prob.	Maintenance/ Breakdown Cost (Rs. Lakh)	Prob.	New Purchase	200	0.5	60	0.6	10	0.4	Second-Hand	120	0.3	50	0.5	20	0.5	Rental Basis	40/month	0.2	55	0.7	5	0.3
Option	Cost (Rs. Lakh)	Prob.	Monthly Revenue (Rs. Lakh)	Prob.	Maintenance/ Breakdown Cost (Rs. Lakh)	Prob.																											
New Purchase	200	0.5	60	0.6	10	0.4																											
Second-Hand	120	0.3	50	0.5	20	0.5																											
Rental Basis	40/month	0.2	55	0.7	5	0.3																											
	Draw decision tree diagram and indicate best decision.																																
6a	A developer must select between two tower cranes for a high-rise project in Mumbai	10	3	4	4&5																												

		Description	Crane A	Crane B	
		Initial cost ₹	₹ 1.2 Cr	₹1.8 Cr	
		Useful life in years	10	10	
		Salvage value at the end of life ₹	₹ 20,00,000	₹40,00,000	
		Annual maintenance cost ₹	₹ 10,00,000.0	₹ 6,00,000.0	
At 14% interest, compare using Present Worth method and Future Worth methods . Discuss sensitivity if interest rate changes to 10%.					
6a	It is proposed to prepare a risk management plan for High-rise building. Discuss the steps in it and classify the risks category wise and discuss their mitigation measure.	10	1 & 2	2	1 & 2
7 a	It is proposed to carryout FMEA analysis in case of implementation of safety management system for high-rise building project. Discuss in detail steps of FMEA process.	10	2	2	3
7b	L & T Constructions plans a new venture for precast segments in a metro flyover project. • Output of segments per annum: 10,000 nos • Expected sales revenue per annum: ₹40,00,00,000 • Fixed costs: ₹8,00,00,000 • Variable costs: ₹20,00,00,000 (a) If the selling price per segment drops to ₹3,500, find its effect on BEP. (b) If fixed costs rise to ₹9,50,00,000 due to safety compliance, find its effect on BEP. (c) If variable costs increase by 12% due to cement price hike, find its effect on BEP.	10	3	3	5



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End Semester Examination/ Re-Examination, May /June 2026

Program: T. Y. B. Tech. Civil

Sem-VI

Duration: 3 Hour

Course Code: PE -BTC - 663

Maximum Points: 100

Course Name: Traffic Engineering & Control (Elective)

Semester: VI

Notes:

04/06/26

- (i) Question 1 is compulsory
- (ii) Solve any four out of remaining six questions
- (iii) Assume suitable data if required
- (iv) Use graph paper if required

Q.No.	Questions	Points	CO	BL	module
Q.1					
a	How will you conduct spot speed study in the field by (i) Using Endoscope (ii) Direct timing procedure.	10	01	02	01
b	Discuss importance of road sign. Also, state the general principal for installation of signals.	10	02	02	05
Q.2.					
a	Discuss with and example the term i. Running speed and Journey speed ii. Space mean speed and time mean speed	08	01	01	01
b	The spot speed study were carried out at a stretch of highway. The consolidated data related to speed is given in the table -I. Plot S - Curve and determine, (i) Upper speed limit (ii) Lower speed limit (iii) speed for Geometric Design and (iv) Model speed.	12	01	03	02
Q.3					
a	Discuss normal density function and standard normal density function of normal probability distribution curve.	08	02	02	02
b	The Street ABCD run from north to south, the length of each section is given in table -II. The details of observations of moving observer team are given in table - III. Calculate traffic flow and running speed in each direction. Also, calculate journey speed in each direction	12	02	03	01



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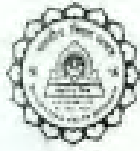
(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai - 400058



End Semester Examination/ ~~Re-Examination~~, May /June 2026

Q.4.					
	Write short notes on				02
a	(i) Null Hypothesis and Alternative Hypothesis (ii) One tail Test and Two Tail test	08	01	02	
b	it was decided to upgrade the geometric feature of the road. The spot speed study were carried ou before and after upgradation. The raw data related to spot speed in km/hr before and after upgradation in geometric features is shown in table iv. Test with the hypothesis that at 5 % level of significance whether there is improvement in the speed due to upgradation in geometric features.	12	01	03	02
Q.5.					
a	Explain Passenger Car Unit (PCU). Also, tabulate the values of PCU for slow moving vehicles and fast moving vehicles on rural road.	08	02	02	07
b	There are three sources A, B and C from which aggregate can be supply for the construction of road. These aggregate to be supply at four destinations D, E, F and G. T maximum capacity of aggregate available at each source A, B and C are 5000, 25000 and 10000 respectively. The amount of demand at destinations D, E, F and G are 5000, 15000, 15000 and 15000 respectively. The unit transportation cost of aggregate from sources to destinations are shown in table - v. Calculate the initial feasible solution by (i) N – W corner method and (ii) least cost method	12	02	03	03
Q.6.					
a	Enlist the advantage and disadvantage of traffic signals.	05	01	01	05
b	Write short notes on traffic control signals	05	01	01	05



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c	The town is divided in to four zones and O – D study were carried out. The O – D matrix for traffic pattern are shown in table below: Determine the future trip by (i) Uniform growth factor method and (ii) Average growth factor method <table><tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>1</td><td>75</td><td>160</td><td>225</td><td>300</td></tr><tr><td>2</td><td>200</td><td>125</td><td>300</td><td>175</td></tr><tr><td>3</td><td>170</td><td>260</td><td>75</td><td>200</td></tr><tr><td>4</td><td>110</td><td>300</td><td>120</td><td>140</td></tr></table>		1	2	3	4	1	75	160	225	300	2	200	125	300	175	3	170	260	75	200	4	110	300	120	140	10	02	03	05
	1	2	3	4																										
1	75	160	225	300																										
2	200	125	300	175																										
3	170	260	75	200																										
4	110	300	120	140																										
Q.7.																														
a	Write short notes on vehicle occupancy survey	04	01	01	04																									
b	In analysing the employment structure of household in an urban area, in connection with trip generation study, it has been found that there are 3000 household of 4 members each. Find the probability that a particular household of this size has 0,1,2,3, and 4 employed residents.	08	01	03	02																									
	A single lane road of 50 km long is to be widen to two lane road at the cost of Rs. 45 L per km including all improvement. The vehicle operation cost of single lane road is 18 Rs. Per km per vehicle and the vehicle operation cost of two lane road is 16 Rs. Per km per vehicle. The maintenance cost of existing single lane road and proposed two lane raod is Rs. 40,000 per km per annum and Rs. 60,000 per km per annum respectively. If the rate of interest on the money utilized for improvement of road from single lane to two lane is 12 %. Determine the project is economical or not.	08	02	03	06																									



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End Semester Examination/ Re-Examination, May /June 2026

Q.2.(b), Table - I

Speed range	10 -20	20 -30	30 -40	40- 50	50-60	60-70	70-80	80-90	90-100
Frequency (f)	15	35	80	105	210	250	140	40	25

Q.3.(b), Table - II

Road Section	Length (m)
AB	600
B	INTERSECTION
BC	1000
C	INTERSECTION
CD	500

Q.3.(b), Table - III

Direction of travel	section	Time (Sec.)	Vehicle count		
			Opp. Dire.	overtaking	overtaken
SOUTH BOUND TRAFFIC	AB	155	22	4	3
	B	20	—	—	—
	BC	182	30	3	2
	C	15	—	—	—
	CD	145	25	4	3
NORTH BOUND TRAFFIC	DC	135	55	2	2
	C	14	—	—	—
	CB	155	50	4	4
	B	20	—	—	—
	BA	140	45	1	1



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End Semester Examination/ ~~Re~~-Examination, May /June 2026

Q.iv (b), Table - iv

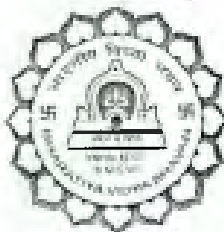
Average spot speed before upgradation							
45	50	56	57	60	46	65	46
53	51	54	58	62	55	53	52
59	62	49	59	60	52	47	49
Average spot speed after upgradation							
45	52	58	57	61	63	66	48
53	55	57	68	62	65	55	54
61	62	62	54	60	52	48	65

Q.v (b), Table -v

	D	E	F	G	Supply
A	10	0	20	11	15000
B	12	7	9	20	25000
C	0	14	16	18	10000
Demand	5000	15000	15000	15000	

Table 2: Critical Values of Student's *t*-Distribution

d.f.	Level of significance for two-tailed test					d.f.
	0.20	0.10	0.05	0.02	0.01	
	Level of significance for one-tailed test					
	0.10	0.05	0.025	0.01	0.005	
1	3.078	6.314	12.706	31.821	63.657	1
2	1.886	2.920	4.303	6.965	9.925	2
3	1.638	2.353	3.182	4.541	5.841	3
4	1.533	2.132	2.776	3.747	4.604	4
5	1.476	2.015	2.571	3.365	4.032	5
6	1.440	1.943	2.447	3.143	3.707	6
7	1.415	1.895	2.365	2.998	3.499	7
8	1.397	1.860	2.306	2.896	3.355	8
9	1.383	1.833	2.262	2.821	3.250	9
10	1.372	1.812	2.228	2.764	3.169	10
11	1.363	1.796	2.201	2.718	3.106	11
12	1.356	1.782	2.179	2.681	3.055	12
13	1.350	1.771	2.160	2.650	3.012	13
14	1.345	1.761	2.145	2.624	2.977	14
15	1.341	1.753	2.731	2.602	2.947	15
16	1.337	1.746	2.120	2.583	2.921	16
17	1.333	1.740	2.110	2.567	2.898	17
18	1.330	1.734	2.101	2.552	2.878	18
19	1.328	1.729	2.093	2.539	2.861	19
20	1.325	1.725	2.086	2.528	2.845	20
21	1.323	1.721	2.080	2.518	2.831	21
22	1.321	1.717	2.074	2.508	2.819	22
23	1.319	1.714	2.069	2.500	2.807	23
24	1.318	1.711	2.064	2.492	2.797	24
25	1.316	1.708	2.060	2.485	2.787	25
26	1.315	1.706	2.056	2.479	2.779	26
27	1.314	1.703	2.052	2.473	2.771	27
28	1.313	1.701	2.048	2.467	2.763	28
29	1.311	1.699	2.045	2.462	2.756	29
Infinity	1.282	1.645	1.960	2.326	2.576	Infinity



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Sardar Patel College of Engineering

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Munshi Nagar, Andheri (West), Mumbai - 400058



END SEM/RE-EXAM EXAMINATION -MAY / JUNE 2026

Program: Civil Engineering *Third Year*

Duration: 3hr

Course Code: PC-BTC601

Maximum Points: 100

Course Name: Construction Engineering and Management

Semester: VI

Instructions:

1. Question no. 1 is compulsory
2. Attempt any 4 questions out of remaining 6 questions.
3. Neat diagrams must be drawn wherever necessary.
4. Assume Suitable data if necessary and state it clearly.

Sem VI
13/7/26

Q. No.	Questions	Points	CO	BL	Module
1	a A highway construction project in Mumbai has experienced significant delays and budget escalation. As a project management engineer, analyze the common causes of time and cost overruns in highway projects and suggest preventive measures using the PDCA (Plan-Do-Check-Act) approach.	10	CO3	BL3	5
	b Discuss the cost of accidents and cost of quality.	10	CO2	BL3	6
2	A contract is awarded to you for the construction of Highway project connecting Nashik and Mumbai.	20	CO3	BL2	2, 5, 4
	a) Draw WBS for the project. b) Draw a site layout plan for a project indicating batching plant, storage, labour camp, and equipment yard. c) Suggest suitable organization structure for the same. d) List the records to be maintained on the site for construction of Highway project.				
3	a For the network diagram given, Find project duration,	10	CO2	BL2	3
	<pre> graph LR 1((1)) -- A[6] --> 2((2)) 1 -- J[3] --> 4((4)) 1 -- G[9] --> 3((3)) 2 -- B[4] --> 5((5)) 2 -- D[2] --> 7((7)) 3 -- K[9] --> 6((6)) 4 -- H[10] --> 6 4 -- I[6] --> 9((9)) 5 -- C[7] --> 6 6 -- L[3] --> 9 7 -- E[4] --> 8((8)) 8 -- F[10] --> 10((10)) 9 -- M[5] --> 10 </pre>				

		a) Perform forward pass and backward pass calculations. b) For the network shown find out critical path. c) Find earliest start time, EFT, LST and LFT of the activity. d) Calculate total float and free float and tabulate your result																																																
	b	Discuss the benefits of construction automations as against manual method of work.	5	CO1	BL2	4																																												
	c	Discuss the concept of resource levelling and resource smoothing. Explain their importance.	5	CO2	BL4	3																																												
	a	Prepare A, B and C ranking of the different items for the data given below. Also draw the graph.	10	CO2	BL2	4																																												
4		<table><tr><th>Sr. No.</th><th>Material</th><th>Annual Consumption</th><th>Unit cost in ₹.</th></tr><tr><td>1</td><td>I</td><td>1200</td><td>1000</td></tr><tr><td>2</td><td>II</td><td>3100</td><td>3500</td></tr><tr><td>3</td><td>III</td><td>2200</td><td>90</td></tr><tr><td>4</td><td>IV</td><td>4100</td><td>100</td></tr><tr><td>5</td><td>V</td><td>3500</td><td>990</td></tr><tr><td>6</td><td>VI</td><td>5500</td><td>1200</td></tr><tr><td>7</td><td>VII</td><td>200</td><td>80</td></tr><tr><td>8</td><td>VIII</td><td>100</td><td>75</td></tr><tr><td>9</td><td>IX</td><td>250</td><td>40</td></tr><tr><td>10</td><td>X</td><td>150</td><td>30</td></tr></table>	Sr. No.	Material	Annual Consumption	Unit cost in ₹.	1	I	1200	1000	2	II	3100	3500	3	III	2200	90	4	IV	4100	100	5	V	3500	990	6	VI	5500	1200	7	VII	200	80	8	VIII	100	75	9	IX	250	40	10	X	150	30				
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10	X	150	30																																															
b	List the project participant as well as equipment required in the construction of Highway project connecting Nashik and Mumbai.	6	CO2	BL2	1																																													
c	A project involves an initial outlay of ₹ 40,00000/-	4	CO1	BL2	4																																													
	The salvage value at the end of 5 year=₹ 3,00,000/-																																																	
	<table><tr><th>End of year</th><th>O & M Cost ₹</th><th>Revenue ₹</th></tr><tr><td>1</td><td>3,00000.0</td><td>9,00000.0</td></tr><tr><td>2</td><td>4,50000.0</td><td>11,00000.0</td></tr><tr><td>3</td><td>5,00000.0</td><td>13,00000.0</td></tr><tr><td>4</td><td>6,50000.0</td><td>15,00000.0</td></tr><tr><td>5</td><td>7,00000.0</td><td>17,00000.0</td></tr></table>					End of year	O & M Cost ₹	Revenue ₹	1	3,00000.0	9,00000.0	2	4,50000.0	11,00000.0	3	5,00000.0	13,00000.0	4	6,50000.0	15,00000.0	5	7,00000.0	17,00000.0																											
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5	7,00000.0	17,00000.0																																																
	Draw cash flow diagram.																																																	
5	a	Following network diagram represents activities associated with the project	10	CO2	BL3	3																																												
	<pre>graph LR 1((1)) -- "2-4-7" --> 2((2)) 2 -- "1-1-2" --> 3((3)) 2 -- "2-4-5" --> 4((4)) 3 -- "1-2-3" --> 5((5)) 4 -- "1-2-3" --> 6((6)) 5 -- "3-5-6" --> 7((7)) 6 -- "7-10-13" --> 8((8)) 7 -- "4-6-10" --> 9((9)) 8 -- "4-7-9" --> 10((10)) 9 -- "5-7-10" --> 10 10 -- "1-1-2" --> 11((11))</pre>																																																	

6	Determine																																												
	i) Expected completion time, Show Critical path																																												
	ii) Variance of each activity																																												
	iii) The earliest and latest completion time of each event.																																												
	iv) Calculate the probability of meeting the schedule for the last event, if the schedule time is 26 days.																																												
	b	Explain hazards in rigid pavement construction (hot weather concreting, heavy equipment movement) and mitigation measures.	7	CO2	BL2	5																																							
	c	Differentiate AOA and AON	3	CO1	BL1	3																																							
	a	Prepare a checklist for Excavation, Piling work.	10	CO3	BL2	6																																							
	b	Optimize the project duration	10	CO3	BL3	7																																							
		<table><tr><td></td><td colspan="2">Normal</td><td colspan="2">Crash</td></tr><tr><td>Activity</td><td>Time, days</td><td>Cost ₹</td><td>Time, days</td><td>Cost ₹</td></tr><tr><td>1-2</td><td>3</td><td>300</td><td>2</td><td>400</td></tr><tr><td>2-3</td><td>6</td><td>480</td><td>4</td><td>520</td></tr><tr><td>2-4</td><td>7</td><td>2100</td><td>5</td><td>2500</td></tr><tr><td>2-5</td><td>8</td><td>400</td><td>6</td><td>600</td></tr><tr><td>3-4</td><td>4</td><td>320</td><td>3</td><td>360</td></tr><tr><td>4-5</td><td>5</td><td>500</td><td>4</td><td>520</td></tr></table>		Normal		Crash		Activity	Time, days	Cost ₹	Time, days	Cost ₹	1-2	3	300	2	400	2-3	6	480	4	520	2-4	7	2100	5	2500	2-5	8	400	6	600	3-4	4	320	3	360	4-5	5	500	4	520			
	Normal		Crash																																										
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2-5	8	400	6	600																																									
3-4	4	320	3	360																																									
4-5	5	500	4	520																																									
Indirect cost per day for the project is ₹ 100/-																																													
a) Draw network, Find critical path.																																													
b) Find the normal duration and cost of the project.																																													
c) Draw time scaled diagram for each stage of crashing.																																													
d) Determine optimum duration and corresponding cost of the project.																																													
e) Draw the graph of direct cost, indirect cost and total cost.																																													
7	a	A construction company purchases 35,000 bags of cement annually. Each bag of cement costs ₹ 450 and the cost incurred in procuring each lot is ₹ 350. The cost of carrying is 25%.What is the most economic order quantity? What is the average inventory level? If the lead time of procuring cement is 4 weeks, determine the reorder point.	6	CO2	BL2	6																																							
	b	It is proposed to select a project manager for the construction of Highway project discuss the required skills to be considered while selection.	8	CO1	BL2	7																																							
	c	Discuss and differentiate resource levelling and resource smoothening.	6	CO1	BL1	4																																							



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End Semester Exam May 2026 / Re-Exam - July 2026

Program: B.Tech - Civil Engineering

Duration: 3 Hour

Course Code: PC-BTC602

Maximum Points: 100

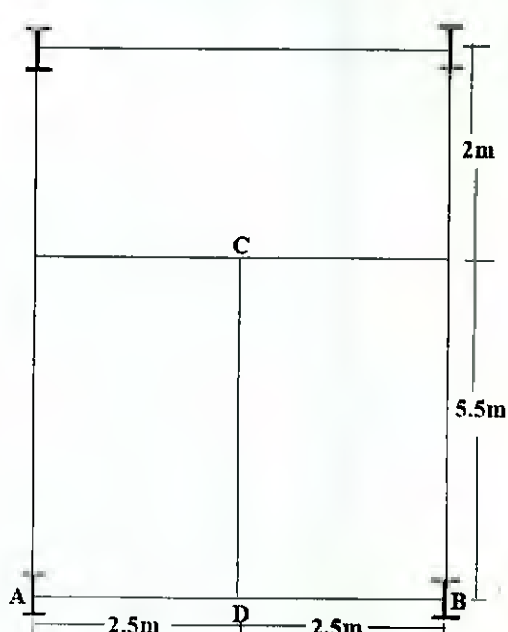
Course Name: Design Of Steel Structures

Semester: VI

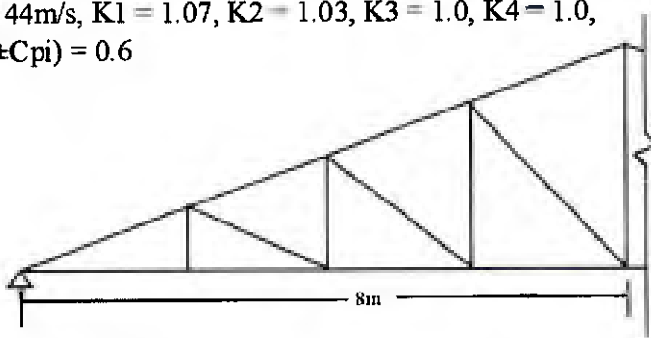
14/7/26

Notes:

1. Attempt any 5 main questions. Answers to all sub-questions should be grouped together
2. Assume any missing data and state the same clearly
3. Use of IS 800-2007 and steel tables is allowed
4. Draw neat sketches to illustrate your answers
5. For all steel plates and angles, $f_y = 250\text{MPa}$, $f_u = 410\text{MPa}$

Q.No.	Questions	Points	CO	BL	Module
1	A floor of hall has beam layout as shown in figure below:  RCC slab depth = 150mm; Floor finish load = 1.5kN/m^2 Live load = 2.5kN/m^2; Wall thickness = 230mm All beams support walls of height 2.5m <i>Assuming the beam to be laterally supported - Design beam CD. Design connection between beam AB and CD (beam AB is of ISMB 500)</i>	20	1,3,4	4	1,6,7
2	The member of a roof truss carries the following unfactored loads : DL = 60kN (Tensile); LL = 55kN (Tensile); WL = 60kN (Compressive)	20	1,2,3	4	1,2,3,4

**End Semester Exam-May 2026/Re-Exam – July 2026**

	a. What will be the design loads as per IS 800:2007 load combinations? b. Design the element as a tension member and also design its connection with 10mm thick gusset plate using 4.6grade bolts c. Check the member designed above for the safety in compression according to the appropriate load combinations. Length of member = 2.2m				
3.a)	A single angle strut (loaded through single leg) carries a design compressive force of 118kN. The length of member between centres of intersection is 1.5m. Design the section as per IS 800:2007. Assume the connection to be hinged with two bolts at each end	10	2	3	3
3.b)	A column carries a design axial load of 1500kN. Design the column section using rolled steel section when both ends are restrained against translation only. Length of member is 3.5m	10	3	3	3
4.	Design a built up laced column to carry 1850kN design axial load using two channels facing back to back. Also design lacing and its connection using 4.6grade bolts. The column is fixed at both ends and the clear length is 5m. Draw neat sketch showing all the details	20	2	3	3
5.a)	Design a stiffened seat connection for an ISMB 350 to transfer 86kN factored reaction to ISHB 400 using 4.6grade bolts. Draw neat sketch to show connection details	15	4	3	7
5.b)	Evaluate the load at each panel point due to wind load for the following details : Spacing between trusses = 6.5m; Rise = 4m; $V_b = 44\text{m/s}$, $K_1 = 1.07$, $K_2 = 1.03$, $K_3 = 1.0$, $K_4 = 1.0$, $(C_{pe} \pm C_{pi}) = 0.6$ 	05	1,3	3	1,4
6.a)	Design a gusseted base connection for a column of section ISHB 300 to transfer a design load of 1050kN on a concrete pedestal of M20 grade. Use 4.6 grade bolts of 20mm diameter.	12	3	3	5
6.b)	Design a welded connection for a single angle tension member ISA 150x150x15. The angle is subjected to an axial force of 250kN.	08	2	3	1
7.a)	Explain the classification of sections : plastic, compact, semi-compact and slender based on moment – rotation characteristics	05	1	2	1



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~~End Semester Exam May 2026/Re-Exam - July 2026~~

7.b)	Explain the various failure modes of bolted connections.	05	2	2	1
7.c)	A simply supported beam ISMB 400 has been used over a span of 5m to carry a design load of 32kN/m. Check the safety of the beam in <i>shear, flexure and deflection</i> when the beam is <i>laterally unsupported</i>	10	3	4	6



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B

END SEMESTER May 2026 / RE - EXAM July 2026

Program: Civil Engineering *Third Year*

Duration: 3 Hours

Course Code: PC-BTC603

Maximum Points: 100

Course Name: Foundation Engineering

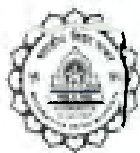
Semester: VI

Note:

Sem VI 15/7/26

1. Question 1 is compulsory. Attempt any four out of remaining six questions
2. Write units everywhere. Use $\gamma_w = 9.81 \text{ kN/m}^3$
3. Make reasonable assumptions where required and state them clearly. Justify where possible.
4. CO: Course Outcome, BL: Blooms Taxonomy level

Q. No.	Questions	Points	CO	BL	Module No.
1	a. What is MSEW? Explain how it is a more green and economical alternative to conventional gravity wall	5	2	3	2
	b. Calculate the efficiency of a group of 3x3 piles constructed in stiff clay. The piles are 400 mm in diameter and 15 m long with spacing of 3.1 d. What is the typical value of efficiency for piles driven in granular soils?	5	4	3	4
	c. As a geotechnical peer reviewer of a single storey industrial structure, you notice that the structural engineer has provided RCC isolated footing at depth of 30 cm below GS to reduce excavation cost as competent strata is available near the GS. Give your comments and recommendations with suitable reasons.	5	3	4	3
	d. Calculate the at-rest, active and passive earth pressure coefficient for soil with friction angle of 36° .	5	1	3	1
2	a. What is CPRF? Explain the interactions considered in load transfer and design of CPRF. Explain pile enhanced raft.	5	3	3	5
2	b. Draw the typical cross section of a caisson and clearly label steining, well curb and bottom plug. Where are caissons most commonly used?	5	4	3	5
2	c. For the new hostel building construction, soil investigation consisted of drilling one borehole as shown in Figure 1. Determine the length of a single pile of diameter 45 cm if the expected load is 1010 kN and factor of safety required is 2.5.	10	4	4	4
3	a. A retaining wall 9 m high retains granular fill with unit weight of 18 kN/m^3 with level backfill. The active thrust on the wall is 180 kN/m length of the wall. It is required to increase the height of the wall but the thrust on the wall needs to remain the same. The backfill soil in top 4.5 m height is removed and replaced by	10	1	4,5	1



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B

END SEMESTER May 2026 / RE - EXAM July 2026

		cinders (wood ash) with unit weight 9 kN/m^3 . Assuming friction angle for soil and cinders to be same, determine the additional height the wall can be increased if the additional height also is backfilled with cinders.				
	b.	The foundation of an RCC boundary wall is to be constructed in c- ϕ soil with cohesion of 26 kPa, friction angle 36° , and bulk unit weight of 19 kN/m^3 . If the foundation width is 1.5 m and depth of embedment is 1.2 m, estimate the bearing capacity if GWT is at 3.5 m below ground surface using IS code recommendations. Neglect depth factors.	10	3	4	3
4	a.	What is punching shear failure? In which type of soils is it likely to occur? Discuss in detail the differences between general shear and local shear failure.	5	3	3, 4	3
	b.	Discuss the importance of providing drainage behind a retaining structure.	5	2	4	2
	c.	A pile load test was carried out on a pile 30 cm in diameter and having a length of 12 m as per IS 2911 (part 4): 2013. Following observations were noted. Determine the allowable load on the pile as per codal recommendations.	10	4	3	4

Load on pile (kN)	150	200	250	300	400	500	650
Total Settlement (mm)	1.45	2.25	2.75	3.6	5.75	15.3	48.65

5	a.	What is negative skin friction? Discuss measures to prevent it.	5	4	3	4
	b.	Discuss the cases when you would consider ground improvement as a feasible solution for a construction project. List any two ground improvement methods.	5	3, 4	4	5
	c.	For the cantilever retaining wall shown in Figure 2, determine if the wall is safe against overturning.	10	2	4	2
6	a.	An online video shows the engineer using ENR formula for the estimation of the capacity of a bored pile in clay. What comments would you add to such a video? Would you recommend this video to your class-mates/ juniors? Explain your reasons.	5	4	4, 5	4
	b.	For the bore log shown in Figure 1, determine the net ultimate bearing capacity of a square footing of width 4 m. Calculate the safe bearing capacity and allowable bearing capacity assuming the settlements are well within permissible limits. If now a combined footing is to be provided on this soil, determine its dimensions if the footing is to not extend beyond column C1 which has a size of 30 cm x 30 cm and carries a load of 500kN, and column C2 of size 40 cm x 40 cm is placed 3.2 m away from	15	3	4, 5	3



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		column C1 and carries a load of 800 kN				
7	a.	Sketch a typical gravity wall, cantilever wall, counterfort wall and buttress wall and state the major differences between them.	5	2	3	2
	b.	Discuss the advantages and limitations of a plate load test.	5	3	3	3
	c.	A cantilever wall with height of 7 m retains native soil with $c = 26 \text{ kPa}$, $\phi = 32^\circ$, and bulk unit weight of 18.6 kN/m^3 . Determine the passive pressure distribution along the height of the wall, calculate the resultant force, and its point of application.	10			

Project: New Hostel SPCE				Project Number: 26/9		Client: BVB		Boring No. 1			
Logged By: KN				Date	Started: 8/11/25		Bit Type: Tricone		Diameter:		
					Completed: 7/11/25		Hammer Type: Safety				
				Groundwater Depth: NA				Total Depth of Boring: 15 m			
Depth (m.)	Sample Type	Sample Number	Blow Counts (blows/15 cm.)	Graphic Log	Lithology				Remarks	Lab. Test	
					Soil Group Name: <u>modifier, color, moisture density/consistency, grain size, other descriptors</u>						
					Rock Description: <u>modifier, color, hardness/degree of noncementation, bedding and joint characteristics, solutions, void conditions</u>						
4					Brown soft clay with trace silt (CL), moist					$C_u = 30 \text{ kPa}$ $\alpha = 0.95$	
			5/6/6		Brown medium stiff clay (CI), moist					$C_u = 60 \text{ kPa}$ $\alpha = 0.72$	
10											
16			8/12/14		Dark brown hard clay (CH), moist					$C_u = 80 \text{ kPa}$ $\alpha = 0.37$	
					Boulders, possibly highly weathered Basalt rock						
18					No sampling possible						
					Borehole terminated at 18 m depth						
					Backfilled after completion						
					No GWT noted in borehole						

Kayen Geotech

Boring Log: Sheet 1 of 1

☒ Standard Penetration Silt Spoon Sampler (SPT)

☐ California Sampler

☐ Shelby Tube

☐ CPP Sampler

☒ Bulk/ Bag Sample

☐ Stabilized Ground water

☐ Groundwater At time of Drilling

Figure 1



END SEMESTER May 2026 / RE - EXAM July 2026

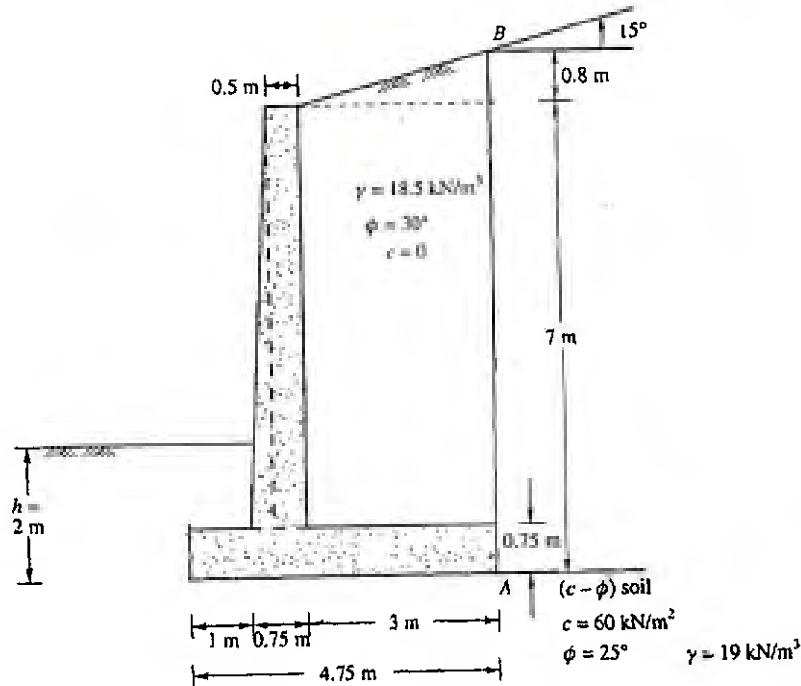


Figure 2

Equations:

$$k_a = \left| \frac{\sec \theta \cos(\phi - \theta)}{\sqrt{\cos(\theta + \delta) + \frac{\sin(\phi + \delta) \sin(\phi - \beta)}{\cos(\beta - \theta)}}} \right|^2$$

$$N_q = e^{\pi \tan \phi} \tan^2(45 + \phi/2)$$

$$N_c = (N_q - 1) \cot \phi$$

$$N_\gamma = 2(N_q + 1) \tan \phi$$



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END SEM / RE-EXAM EXAMINATION MAY / JUN 2026

Program: Third Year B. Tech Civil Engineering

Course Code: PC-BTC604

Course Name: Design of RCC Elements

Duration: 3 Hrs.

Maximum Points: 100

Semester: VI

Instructions for the Students:

1. Attempt any 05 (FIVE) questions
2. Assume suitable data if necessary and state it clearly.
3. Illustrate your answers with neat sketches wherever required.
4. Use of IS 456: 2000 is permitted.

3em VI

16/7/26

Q. No.	Questions	Points	CO	BL	Module No.
1 a	i. Write the assumptions used in design of beams using working stress method.	05	1	3	1
	ii. Determine the design constants for M20 Concrete and Fe 415 steel in Limit state method.	05	1	3	3
1 b	A RCC beam is simply supported over a span of 6 m and carries a superimposed uniformly distributed load of 20 kN/m over the entire span. The cross section of the beam is 300 mm X 600 mm. If the grade of concrete is M30 and grade of the steel is Fe-415, determine the area of tension steel required. Use Working Stress Method	10	2	4	2
2 a	A RCC beam is simply supported over a span of 8 m and has a cross section of 300 mm X 600 mm. The beam is reinforced with 4 bars of 20 mm diameter on tension side and 3 bars of 20 mm diameter on compression side. If the grade of concrete is M30 and grade of the steel is Fe-415, determine the maximum superimposed uniformly distributed load the beam can carry over the entire span. Use Working Stress Method.	10	2	3	2
2 b	A RCC beam is simply supported over a span of 5 m and has a cross section of 300 mm X 600 mm. the beam is reinforced with 4 bars of 20 mm diameter on tension side. If the grade of concrete is M30 and grade of the steel is Fe-415, determine the maximum superimposed uniformly distributed load the beam can carry over the entire span. Use Limit State Method.	10	2	3	4

**END SEM / RE-EXAM EXAMINATION MAY / JUN 2026**

3 a	A RCC beam is simply supported over a span of 8 m and carries a superimposed uniformly distributed load of 40 kN/m over the entire span. The cross section of the beam is 300 mm X 600 mm. If the grade of concrete is M30 and grade of the steel is Fe-415, determine the area of compression steel and tension steel required assuming a balanced doubly reinforced section. Use Limit State Method .	10	2	4	4
3 b	A T beam has following properties: Width of Flange = 1800 mm Depth of Flange = 120 mm Width of Web = 300 mm Effective depth = 550 mm The beam is subjected to a factored bending moment of 600 kN-m. If the grade of concrete is M30 and grade of the steel is Fe-415, determine the area of tension steel required. Use Limit State Method .	10	2	4	4
4 a	A simply supported beam of span 8 m carries a superimposed uniformly distributed load of 40 kN/m over the entire span. The beam has a cross section of 300 mm X 600 mm and is reinforced with 5 bars of 25 mm diameter on tension side. The width of support is 230 mm. Design shear reinforcement using vertical stirrups considering the grade of concrete as M30 and grade of the steel as Fe-415. Note that 2 bars of 25 mm diameter are bent up at 45° near the support. Use Limit State Method .	10	2	5	4
4 b	A beam has a cross section of 300 X 750 mm and is subjected to a factored bending moment of 100 kN-m, factored torsional moment of 60 kN-m and a factored shear force of 80 kN. If the grade of concrete is M30 and grade of the steel is Fe-415, determine the area of steel required and the shear reinforcement required in the form of vertical stirrups only. Use Limit State Method .	10	2	5	4
5 a	A RCC Column has a dimension of 600 mm X 900 mm. it is reinforced with 12 bars of 25 mm diameter as main reinforcement. The Column has unsupported length of 3 m and both ends of the column are effectively held in position and restrained against rotations. Determine the load carrying capacity of the column if concrete grade is M30 and steel grade is Fe-415. Use Limit State Method .	10	3	4	6



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5 b	A RCC Column has a dimension of 375 mm X 600 mm. it is reinforced with 12 bars of 25 mm diameter as main reinforcement. The Column has unsupported length of 3 m and both ends of the column are effectively held in position and restrained against rotations. Determine the maximum load resisted by the column at an eccentricity of 80 mm about minor axis if concrete grade is M30 and steel grade is Fe-415. Use Limit State Method .	10	3	4	6
6	A slab is to be designed over a room size of 3.2 m X 7.5 m, measured internally. The slab is resting on 230 mm thick brick walls on all 4 sides. Live load on the slab is expected as 4 kN/m ² and floor finish load as 2 kN/m ² . The grade of concrete is M30 and grade of steel is Fe-415. Design the slab and sketch the reinforcement details.	20	3	5	5
7	A column has a dimension of 400 mm X 1200 mm and carries an axial compressive load of 2000 kN at service stage. Design an isolated pad footing for the column if safe bearing capacity of soil is 250 kN/m ² . Assume the grade of concrete as M30 and grade of the steel as Fe-415. Use Limit State Method .	20	4	5	7

ϵ_{sc}	f_{sc}	
	Fe-415	Fe-500
0	0	0
0.80 f_{yd}	0.00144	0.00174
0.85 f_{yd}	0.00163	0.00195
0.90 f_{yd}	0.00192	0.00226
0.95 f_{yd}	0.00241	0.00277
0.975 f_{yd}	0.00276	0.00312
1.0 f_{yd}	0.00380	0.00417

Chart 31 COMPRESSION WITH BENDING — Rectangular Section — Reinforcement Distributed Equally on Two Sides

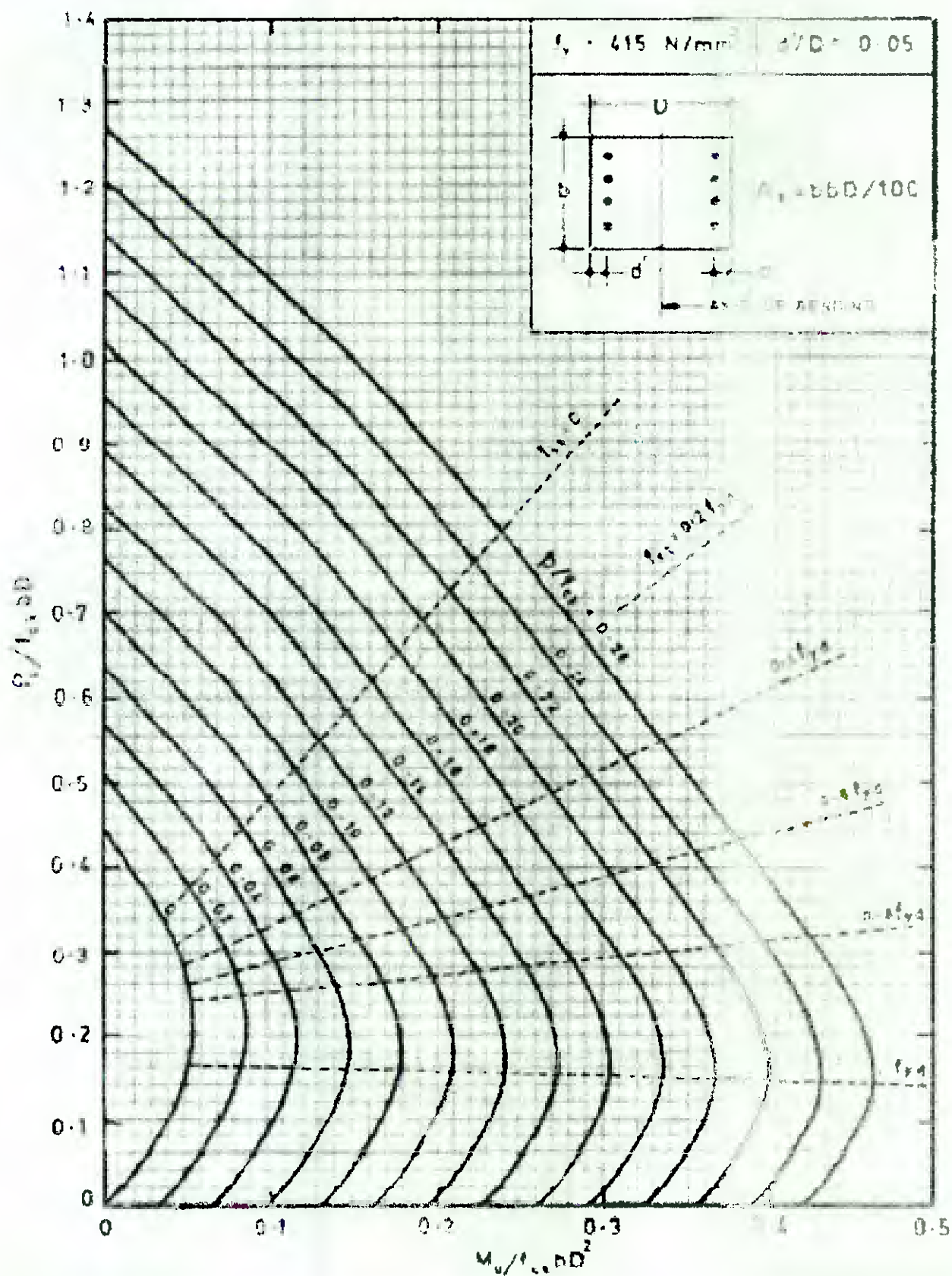


Chart 32 COMPRESSION WITH BENDING — Rectangular Section — Reinforcement Distributed Equally on Two Sides

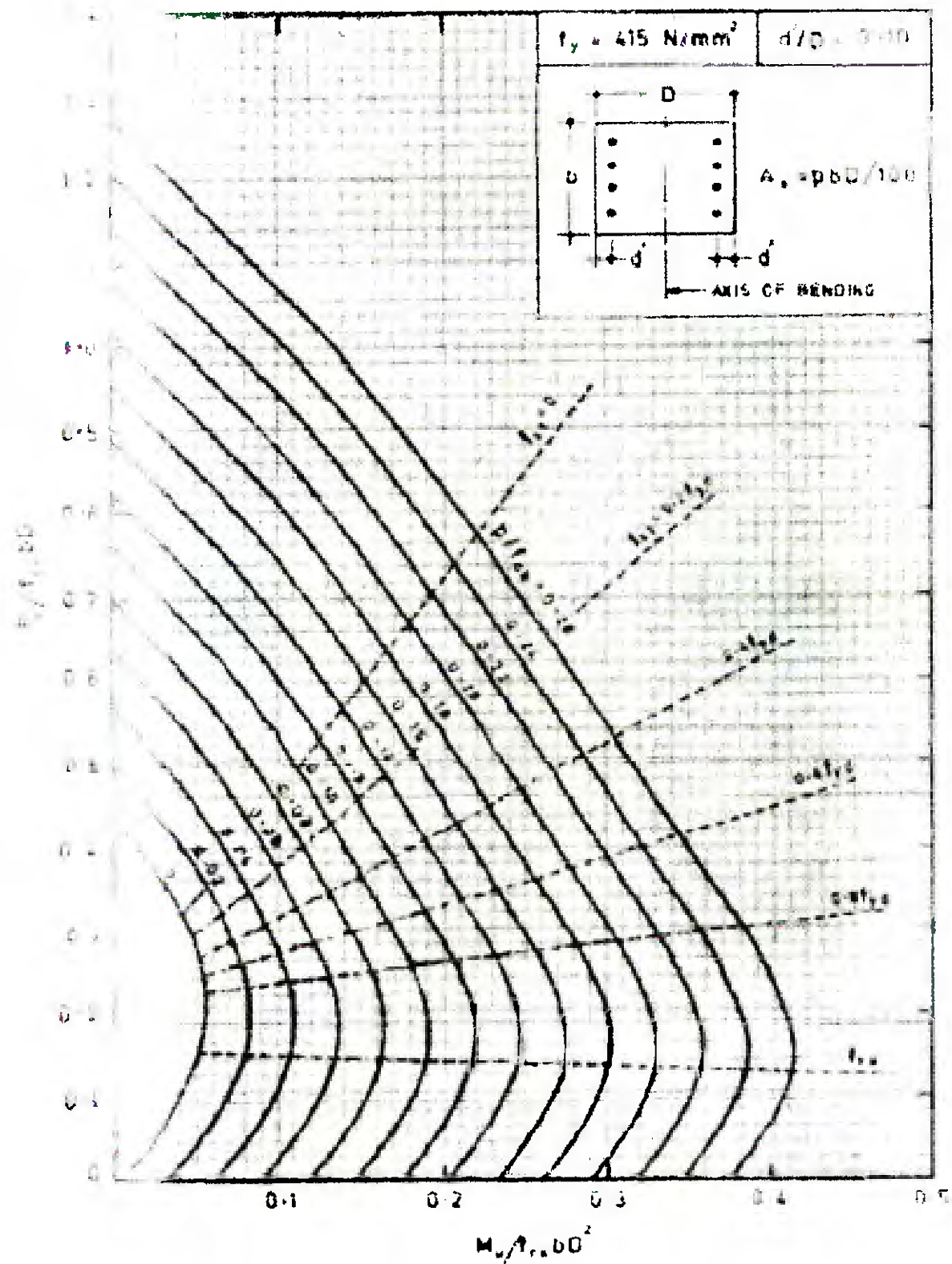


Chart 33 COMPRESSION WITH BENDING — Rectangular Section — Reinforcement Distributed Equally on Two Sides

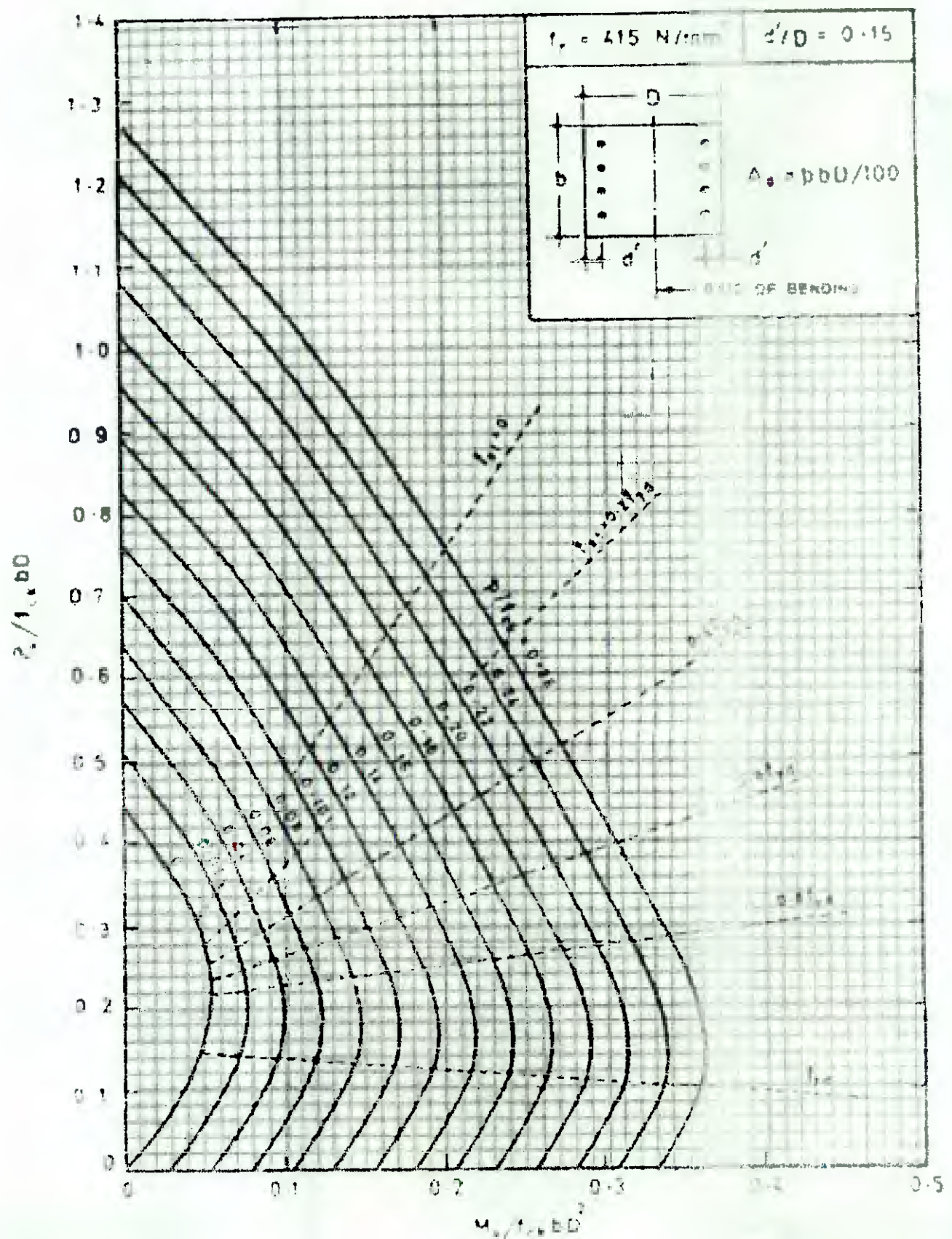
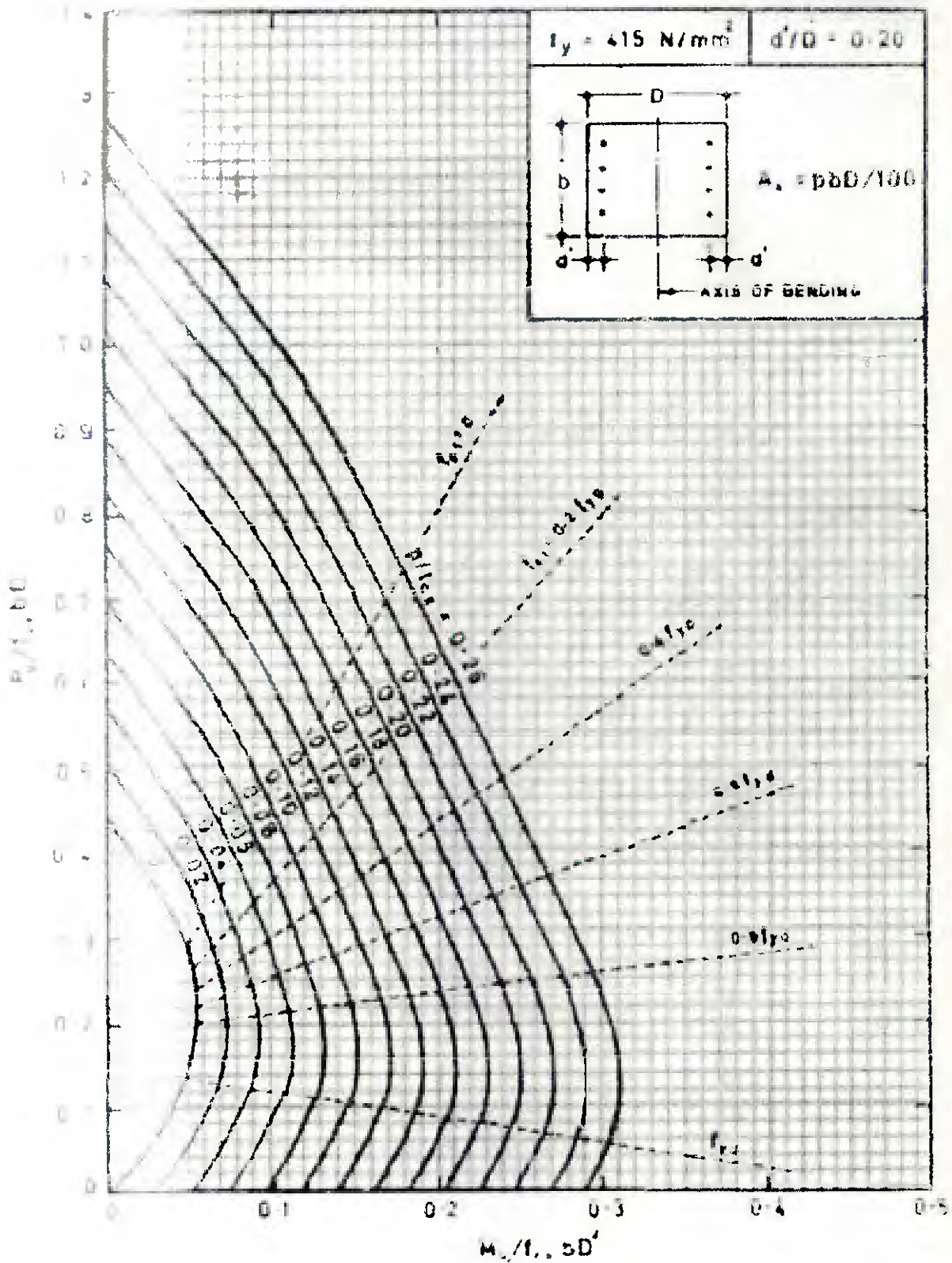


Chart 34 COMPRESSION WITH BENDING — Rectangular
Section — Reinforcement Distributed Equally on Two Sides



**RE-Exam July 2026** **END SEMESTER EXAM MAY JUNE 2026-SET-B**Program: Civil/Mech./Elect. (Minor) **Third Year**

Duration: 3 hrs.

Course Code: MI-BT033

Maximum Points: 100

Course Name: Sustainability Assessment**Sem VI**Semester: VI

- Notes: Solve any five out of seven questions.
- Use illustrations wherever required
- Draw neat sketches/diagrams wherever required and give reasoning wherever required
- Assume suitable data if necessary and state them clearly
- Figure on right indicate maximum points for the given question, course outcomes attained, Bloom's Level and Module Number

17/7/26

Question No.	Questions	Points	CO	BL	MN
Q1a	What is a functional unit as per ISO14040? Describe the functional unit you will choose to compare a paper bag with plastic bag for purchasing clothes in a shopping mall.	5	2	3,4	2
Q1b	Name the diagram shown in Figure 1. Identify the inputs, outputs, and stock if any. What process does the diagram denote? (MFA/LCA/EIA)	5	1	2	1
Pizza Production Flow PIZZAS RAW MASS BAKED PRODUCT WATER LOSS 10 4.85 kg 4.37 kg 485 g Figure 1					
Q1c	Palm oil is one of the world's most traded agricultural commodities. S-LCA studies in Indonesia and Malaysia have documented: land dispossession without Free, Prior and Informed Consent (FPIC); wages of \$3–5/day; debt bondage trapping migrant workers; destruction of peat	10 (3+3+4)	3, 4	4	3, 5



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	lands. The Roundtable on Sustainable Palm Oil (RSPO) was created to address these issues, yet less than 20% of global production is certified as of 2023. A major Indian FMCG company sources 30,000 tonnes of palm oil annually from these regions. a) Conduct a Life Cycle Inventory (LCI) for palm oil used in soap manufacturing. Identify three data sources you would use and explain what social data each source would provide. b) Apply the 'Local Communities' stakeholder category of S-LCA to this palm oil supply chain. List four criteria/indicators (at least one quantitative, one binary) that reveal the social risks. c) Under GRI 414 (Supplier Social Assessment) and BRSR Section C, what obligations does the Indian FMCG company have regarding its palm oil suppliers? Suggest a 5-point Supplier Self-Assessment Questionnaire (SAQ).				
Q2a	How is resource management different from waste management? Explain how MFA helps with both.	5	1	3	1
Q2b	The City Planning Authority has proposed a major urban renewal project. They intend to purchase an abandoned, 80-year-old textile manufacturing mill situated on the banks of a major river and redevelop the land into a "Sustainable Eco-Village" featuring high-density housing, community gardens, and solar infrastructure. Before the city finalizes the purchase and approves the sustainability certification, they hire your environmental engineering firm to conduct an Environmental Impact Assessment. a) Outline the primary steps your team must carry out during the Phase I Environmental Assessment of the old textile mill. b) Discuss the specific conditions or findings from Phase I that would force your team to conduct a Phase II Assessment. c) Outline the steps for Phase II EIA d) Explain how conducting EIA helps with the Sustainability Assessment of the proposed Eco-Village.	10 (2 +2 +3 + 3)	1, 4	3	1, 5
Q3a	A student is assigned to develop a sustainability scorecard for a mid-sized Indian cement company. The company has: high GHG emissions, significant water consumption from limestone mining, 75% male workforce, no formal grievance mechanism for workers, and no third-party audit of its sustainability report. a) Using GRI's Materiality Assessment process (GRI 3), identify four material topics for this cement company, one each from Environmental, Social, Governance, and Economic dimensions. b) For each material topic identified, suggest one quantitative KPI from GRI 300s or 400s standards with its unit of measurement. c) Why does SEBI require BRSR to be signed off by the Board of Directors? How does this improve the credibility of sustainability data compared to voluntary reporting?	5	4	4	5

**RE-Exam July 2022 END SEMESTER EXAM MAY JUNE 2026 SET-B**

Q3b	Explain the terms: System boundary, import and export, industrial ecology, functional unit, allocation.	5	1, 2	2	1, 2																																																												
Q3c	A rural electrification project must choose between two power sources for a 15-year analysis period (discount rate: 8%). <table border="1"><thead><tr><th>Cost Element</th><th>Option A: Solar PV</th><th>Option B: Diesel Generator</th></tr></thead><tbody><tr><td>Capital Cost (Year 0)</td><td>₹42 lakh</td><td>₹18 lakh</td></tr><tr><td>Annual O&M (Years 1–15)</td><td>₹0.80 lakh/yr</td><td>₹4.50 lakh/yr</td></tr><tr><td>Replacement Cost</td><td>Inverter: ₹8 lakh at Year 10</td><td>Engine overhaul: ₹6 lakh at Year 7</td></tr><tr><td>Salvage Value (Year 15)</td><td>₹3 lakh</td><td>₹1 lakh</td></tr></tbody></table> a) Calculate the Life Cycle Cost for both options. b) Which option should the Electrical engineer recommend? Justify with calculations. c) If CO₂ emission cost (Social Cost of Carbon = ₹5,000/tonne) is added for the diesel generator emitting 35 tonnes CO₂/year, which option is preferred under Environmental LCCA?	Cost Element	Option A: Solar PV	Option B: Diesel Generator	Capital Cost (Year 0)	₹42 lakh	₹18 lakh	Annual O&M (Years 1–15)	₹0.80 lakh/yr	₹4.50 lakh/yr	Replacement Cost	Inverter: ₹8 lakh at Year 10	Engine overhaul: ₹6 lakh at Year 7	Salvage Value (Year 15)	₹3 lakh	₹1 lakh	10 (6 +2 +2)	4,5	4	4,5																																													
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Q4	A regional mineral water company is considering switching its primary packaging from single-use PET plastic bottles to single-use glass bottles to improve its sustainability credentials. You have been engaged to conduct a comparative LCA using OpenLCA. System Description: Functional Unit: Packaging and delivering 50,000 litres of mineral water (in 500 mL bottles) to end consumers over one calendar year. System Boundary: Cradle-to-grave (raw material extraction → manufacturing → filling & transport → consumer use → end-of-life). Option A: Single-Use PET Plastic Bottle (500 mL) <table border="1"><thead><tr><th>Life Cycle Stage</th><th>Input/Output</th><th>Value</th><th>Unit</th></tr></thead><tbody><tr><td>Raw Materials</td><td>PET resin (virgin)</td><td>24</td><td>g/bottle</td></tr><tr><td>Manufacturing</td><td>Electricity (grid mix)</td><td>0.011</td><td>kWh/bottle</td></tr><tr><td></td><td>Natural gas (heating)</td><td>0.0018</td><td>m³/bottle</td></tr><tr><td></td><td>Process water</td><td>0.09</td><td>L/bottle</td></tr><tr><td>Transport</td><td>Truck (plant → retailer)</td><td>280</td><td>km</td></tr><tr><td></td><td>Payload per shipment</td><td>20,000</td><td>bottles</td></tr><tr><td>End-of-Life</td><td>Recycling rate</td><td>40%</td><td>—</td></tr><tr><td></td><td>Landfill rate</td><td>60%</td><td>—</td></tr></tbody></table> Option B: Single-Use Glass Bottle (500 mL) <table border="1"><thead><tr><th>Life Cycle Stage</th><th>Input/Output</th><th>Value</th><th>Unit</th></tr></thead><tbody><tr><td>Raw Materials</td><td>Silica sand</td><td>165</td><td>g/bottle</td></tr><tr><td></td><td>Soda ash</td><td>28</td><td>g/bottle</td></tr><tr><td></td><td>Cullet (recycled glass)</td><td>80</td><td>g/bottle</td></tr><tr><td>Manufacturing</td><td>Electricity (grid mix)</td><td>0.031</td><td>kWh/bottle</td></tr><tr><td></td><td>Natural gas (furnace)</td><td>0.012</td><td>m³/bottle</td></tr></tbody></table>	Life Cycle Stage	Input/Output	Value	Unit	Raw Materials	PET resin (virgin)	24	g/bottle	Manufacturing	Electricity (grid mix)	0.011	kWh/bottle		Natural gas (heating)	0.0018	m ³ /bottle		Process water	0.09	L/bottle	Transport	Truck (plant → retailer)	280	km		Payload per shipment	20,000	bottles	End-of-Life	Recycling rate	40%	—		Landfill rate	60%	—	Life Cycle Stage	Input/Output	Value	Unit	Raw Materials	Silica sand	165	g/bottle		Soda ash	28	g/bottle		Cullet (recycled glass)	80	g/bottle	Manufacturing	Electricity (grid mix)	0.031	kWh/bottle		Natural gas (furnace)	0.012	m ³ /bottle	20 (3 +2 +2 +4 +3 +2 +4)	2, 4	4,5	2, 5
Life Cycle Stage	Input/Output	Value	Unit																																																														
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	Process water	0.04	L/bottle
Transport	Truck (plant → retailer)	210	km
	Payload per shipment	20,000	bottles
End-of-Life	Recycling rate	70%	—
	Landfill rate	30%	—

Background Data (Ecoinvent/ELCD Proxies)

Process	Dataset Proxy
PET resin production	Polyethylene terephthalate, granulate, amorphous, at plant
Glass bottle production	Glass bottle, green, at plant
Silica sand	Sand, at mine
Soda ash	Soda ash, dense, at plant
Electricity	Electricity, medium voltage, national grid
Truck transport	Transport, freight, lorry 16–32t, EURO5
PET recycling	Recycling of PET bottles
Glass recycling	Recycling of glass
Landfill (PET)	Disposal, plastics, to sanitary landfill
Landfill (glass)	Disposal, inert material, to landfill

Use CML-IA Baseline with the following four impact categories:

1. Global Warming Potential (GWP 100a) — kg CO₂-eq
2. Acidification Potential (AP) — kg SO₂-eq
3. Eutrophication Potential (EP) — kg PO₄-eq
4. Abiotic Depletion — fossil fuels (ADP-f) — MJ

Questions: Part A: Model Setup and Inventory

1. Define the product system in OpenLCA for Option B (Glass Bottle). List all flows you would create (elementary and product flows), explain how you would link the foreground processes to background datasets, and describe how cullet (recycled glass content) would be handled — specifically whether you would apply allocation and why.
2. Calculate the total transport load in tonne-kilometres (t-km) for each option over the functional unit (50,000 litres = 100,000 bottles of 500 mL). Show all working clearly.
3. The glass bottle uses 80 g/bottle of cullet (recycled glass). Explain two different approaches to modelling this recycled content in OpenLCA and state which approach is more appropriate under the CML methodology.

Part B: Impact Assessment and Comparison

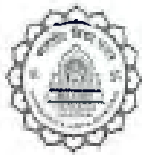
4. After running LCIA for both product systems, the following results are obtained:

Impact Category	PET Bottle (Option A)	Glass Bottle (Option B)
GWP (kg CO ₂ -eq)	3,840	9,150
AP (kg SO ₂ -eq)	14.2	31.6
EP (kg PO ₄ -eq)	2.1	3.8
ADP-f (MJ)	98,400	61,200

Interpret these results across all four categories. Identify the trade-offs, explain the likely drivers behind each result, and provide a justified

**RE-Exam July 2026 END SEMESTER EXAM MAY JUNE 2026-SET-B**

	recommendation to the water company. 5. A contribution analysis for GWP in Option B (Glass Bottle) reveals the following breakdown: <table><tr><th>Process</th><th>Contribution to GWP</th></tr><tr><td>Glass melting furnace (natural gas)</td><td>48%</td></tr><tr><td>Silica sand & soda ash extraction</td><td>14%</td></tr><tr><td>Electricity (manufacturing)</td><td>17%</td></tr><tr><td>Transport</td><td>5%</td></tr><tr><td>Landfill emissions</td><td>9%</td></tr><tr><td>Cullet processing</td><td>7%</td></tr></table> Identify the two dominant hotspots. For each hotspot, propose one specific and technically feasible intervention — at either the manufacturing or supply chain level — that could reduce Option B's GWP. Quantify or estimate the potential GWP saving where possible. 6. The company's pointeting team claims: <i>"Glass is always more sustainable than plastic."</i> Using your LCIA results, critically evaluate this claim. In your answer, refer to at least two impact categories and discuss one contextual factor that could change the conclusion. Part C: Sensitivity Analysis 7. The LCA results for Option B are sensitive to two uncertain parameters: Scenario 1: Increase the glass recycling rate from 70% → 90% Scenario 2: Switch the electricity grid mix from national average → 100% renewable energy for Option B's manufacturing only Answer the following: (a) Which scenario is likely to produce a larger reduction in GWP for Option B, and why? Support your answer with a brief quantitative estimate using the contribution analysis data from Q5. (b) Describe step-by-step how you would implement both scenarios as a sensitivity analysis in OpenLCA using parameters and scenario sets. (c) Based on your sensitivity analysis, assess whether the conclusion from Q4 — that PET has a lower GWP — is robust. Under what specific conditions, if any, could glass become the better option for GWP?	Process	Contribution to GWP	Glass melting furnace (natural gas)	48%	Silica sand & soda ash extraction	14%	Electricity (manufacturing)	17%	Transport	5%	Landfill emissions	9%	Cullet processing	7%				
Process	Contribution to GWP																		
Glass melting furnace (natural gas)	48%																		
Silica sand & soda ash extraction	14%																		
Electricity (manufacturing)	17%																		
Transport	5%																		
Landfill emissions	9%																		
Cullet processing	7%																		
Q5a	Discuss STAMP (SusTainability Assessment & Measurement Principles)	5	1	2	1														
Q5b	An engineering team is testing an older aviation piston engine on a test block. During the trial run, the engine consumes exactly 100 Liters of aviation fuel. Chemical analysis shows that this specific fuel blend contains a lead additive at a concentration of 2.2 g/L. Sensors placed on the exhaust stack measure that exactly 180 g of lead was emitted into the surrounding air during the test. Calculate the total mass of lead entering the system boundary. Draw a simple, labeled MFA system boundary diagram showing the flow of Lead through the engine. Briefly explain where this "missing" lead went and why it matters.	5	1, 4	3	1, 5														



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Q5c	Tata Steel & Unilever Supply Chain Part A — Tata Steel BRSR Data: <table><tr><th>Indicator</th><th>FY2022</th><th>FY2023</th></tr><tr><td>Total GHG Emissions (Scope 1+2), tCO₂e</td><td>27,40,000</td><td>26,10,000</td></tr><tr><td>Crude Steel Production (tonnes)</td><td>19,80,000</td><td>20,40,000</td></tr><tr><td>Energy Consumed (GJ)</td><td>1,62,000,000</td><td>1,58,000,000</td></tr><tr><td>Women in Workforce (%)</td><td>7%</td><td>9%</td></tr><tr><td>LTIFR (Lost Time Injury Frequency Rate)</td><td>0.43</td><td>0.31</td></tr></table> a) Calculate the GHG Intensity (tCO₂e per tonne of crude steel) for FY2022 and FY2023. Comment on the trend. b) Calculate the Energy Intensity (GJ per tonne of crude steel) for both years. Which GRI 300-series standard covers this disclosure? c) Under BRSR, Principle 6 (P6) governs environmental responsibility. Identify THREE specific BRSR P6 disclosures Tata Steel must make, linking each to the data provided above. Part B — Unilever Supply Chain: d) Unilever's Scope 3 emissions account for 66% of its total GHG footprint with 52,000+ suppliers. Explain the challenge of measuring Scope 3 under GRI 305-3 and describe two mechanisms Unilever uses to collect supplier emissions data. e) As Head of Sustainability for Unilever India, map three supplier categories to relevant GRI 300s or 400s standards. Which BRSR Principle governs supplier social assessment?	Indicator	FY2022	FY2023	Total GHG Emissions (Scope 1+2), tCO ₂ e	27,40,000	26,10,000	Crude Steel Production (tonnes)	19,80,000	20,40,000	Energy Consumed (GJ)	1,62,000,000	1,58,000,000	Women in Workforce (%)	7%	9%	LTIFR (Lost Time Injury Frequency Rate)	0.43	0.31	10 (2 x 5)	5	4	5
Indicator	FY2022	FY2023																					
Total GHG Emissions (Scope 1+2), tCO ₂ e	27,40,000	26,10,000																					
Crude Steel Production (tonnes)	19,80,000	20,40,000																					
Energy Consumed (GJ)	1,62,000,000	1,58,000,000																					
Women in Workforce (%)	7%	9%																					
LTIFR (Lost Time Injury Frequency Rate)	0.43	0.31																					
Q6a	Trash Trek Footwear (TT) and Re-loop Runners (RR) are two companies that manufacture shoes in Kanpur, UP. TT uses virgin petroleum plastics and has customers within Kanpur region. It is observed that typically, after 1 year of use, the shoes are thrown into the municipal garbage and landfilled locally. RR makes modular sneakers from recycled plastics and has customers all over the world. When the tread wears out, the customer mails the shoes back to the factory, where the old sole is mechanically ground down to manufacture a new sole. List the specific LCA system boundary for both companies. Discuss the likely environmental hotspot for RR and explain your reasons.	5	1, 4	4	1, 5																		
Q6b	Discuss the contributions by Abel Wolman (1892-1989) and how they relate to the current assessment of sustainability for an organization.	5	2	3	1																		
Q6c	A civil engineering consultancy is undertaking an S-LCA for the construction of a 2 km cable-stayed bridge over a river in Madhya Pradesh. The project involves: land acquisition of 45 acres displacing 3 tribal villages; employment of 1,200 migrant construction workers; procurement of steel from a domestic manufacturer; and a 3-year construction timeline.	10 (4 +3 +3)	3	4	3																		



RE-Exam July 2026 ~~END SEMESTER EXAM MAY JUNE 2026-SET-B~~

	a) Define the Goal & Scope. Identify all five S-LCA stakeholder groups relevant to this bridge project and list one key social concern for each. b) Conduct a preliminary Impact Assessment: classify three identified social impacts as high / medium / low risk. Justify each classification. c) GRI 413 covers 'Local Communities'. How does this standard complement the S-LCA methodology in managing community impact for infrastructure projects in India?				
Q7a	A battery recycling facility processes powdered core of end-of-life electric vehicle batteries using strong acids to recover Lithium. The reactor processes a batch of 5,000 kg of black mass. Chemical analysis shows that it contains 4% Lithium by mass. After the chemical process, the material is split into three final streams. The transfer coefficients for <i>Lithium</i> to these streams are: Stream 1: Target Product: Battery-Grade Lithium Carbonate = 0.85, Stream 2: Solid Waste: Leached Filter Cake/Slag = Unknown, Stream 3: Liquid Waste: Wastewater Effluent = 0.04. Calculate the total mass of pure Lithium entering the reactor per batch. Determine the transfer coefficient of Lithium to Stream 2 Calculate the actual mass of Lithium (in kg) that physically ends up in Stream 1 and Stream 2. From an environmental engineering perspective, briefly explain why the Lithium lost to Stream 3 is significantly harder to manage than the Lithium lost to Stream 2.	5	1, 4	3, 4	1, 5
Q7b	Discuss the elements of the interpretation phase of LCA as per ISO14044. Explain the evaluation checks carried out during the interpretation phase	10 (4+2 +2)	2	3	2
Q7c	What is Sustainable Process index? State its advantages and limitations	5	1	3	1
Q7d	Differentiate between LCA and EIA. How are both different from risk assessment?	5	1, 2	3	1, 2



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END SEMESTER/RE- EXAMINATION: MAY/JUNE 2026

Program: B.Tech. in Civil Engineering *Third Year* Duration: 3 Hours
Course Code: PE-BTC621 Maximum Points: 100
Course Name: Analysis of Indeterminate Structures Semester: VI

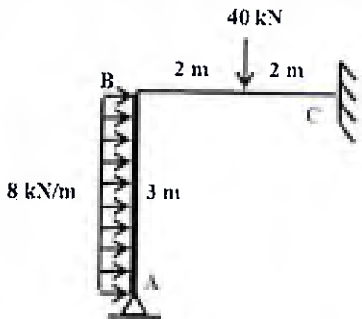
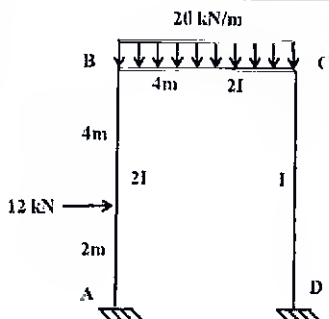
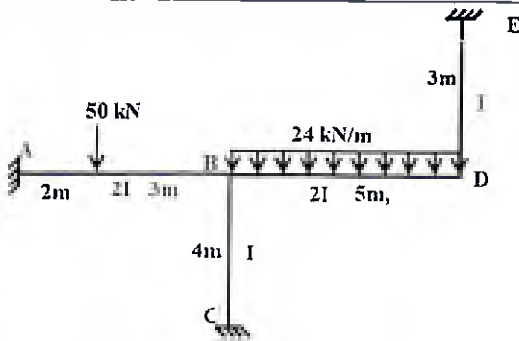
1. Attempt any FIVE questions out of SEVEN questions.
2. Answers to all sub questions should be grouped together.
3. Figures to the right indicate full marks.
4. Assume suitable data if necessary and state the same clearly.

Sem VI

20/7/26

Q.No	Questions	Points	CO	BL	Module
Q1(a)	Using flexibility method, find the reactions at A for the rigid jointed frame loaded as shown in figure below.	10	1	3,4	1
Q1(b)	Find the force in the redundant member BE of the truss loaded as shown in figure below by flexibility method. (Take force in member AC as the redundant force.) Assume AE to be same for all the members.	10	1	3,4	1
Q2(a)	Analyse the continuous beam shown in figure using three moment theorem and find the support moments.	12	1	4	2

**END SEMESTER/RE- EXAMINATION: MAY/JUNE 2026**

Q2(b)	A two hinged parabolic arch of span 24 m and rise 4 m carries a concentrated load of 15 kN at 6m from the right support. Determine the horizontal thrust in the arch. The moment of inertia (MI) of the section of the arch varies as $I = I_0 \sec\theta$, where I_0 = MI of the section at the crown.	08	1	3,4	2
Q3(a)	Using the theorem of least work, find the reactions at A for the rigid jointed frame loaded as shown in figure below.	14	1	3,4	3
					
Q3(b)	Define flexibility coefficient f_{ij} and state the important properties of the flexibility matrix	06	1	3,4	1
Q4	Using slope deflection method, find the unknown displacements and end moments for the frame loaded as shown in the figure below.	20	2	3,4	4
					
Q5(a)	Analyse the rigid jointed frame loaded as shown in the figure below by moment distribution method and find the end moments.	14	2	3,4	5
					



Q5(b)	Find the distribution factors r_{BA} , r_{BC} , r_{CB} and r_{CD} for the continuous beam shown in figure below.	06	2	3	5
Q6(a)	Using stiffness method, find the unknown displacements in the rigid jointed frame loaded as shown in the figure below.	17	2	3,4	6
Q6(b)	What are the conditions to be satisfied while analyzing a structure using plastic analysis?	03	1,2	1,2	7
Q7(a)	Find the shape factor for the unsymmetrical I section with the following data. Top flange - width = 200 mm, thickness = 20 mm Bottom flange - width = 250 mm, thickness = 25 mm Depth of web = 150 mm, thickness of web = 15 mm.	10	3	3,4	7
Q7(b)	A continuous beam is subjected to working loads as shown in figure below. If $M_P = 60 \text{ kN-m}$, calculate the (true) load factor for the beam.	10	3	3,4	7



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END SEM/RE-EXAM EXAMINATION -MAY / JUNE 2026

Program: T Y B. Tech CIVIL

Duration: 3 Hrs

Course Code: PE-BTC623

Sem-VI

Maximum Points:100

Course Name: Repairs and Rehabilitation of Structures

Semester: VI

20/7/26

Notes: Question no.1 is compulsory, solve any 4 questions out of remaining 6 questions

Q.No.	Questions	Points	CO	Module No.
Q.1(a)	What is the objective of maintenance? What are factors affecting maintenance?	08	CO1	1
Q 1(b)	Draw crack patterns for column beam slab frame shown for 1) Corrosion 2) Scaling 3) Flexure over loading 4) Shear overloading 5) Settlement of support 6) Shrinkage and creep	12	CO2	3
Q.2(a)	What is the difference between Strengthening and retrofitting and repairs of concrete structures.	06	CO4	6
Q.2(a)	Explain in detail various methods of retrofitting and how the beams are retrofitted for flexure and shear. Explain with proper sketches	14	CO4	6
Q.3(a)	Explain types of defects develop in columns and reasons for the same with sketches and how they are rectified.	08	CO2	3



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END SEM/RE-EXAM EXAMINATION -MAY / JUNE 2026

Q.3(b)	Explain Importance of NDT and DT for concrete. classify them as tests for strength and test for durability. Explain ultra sonic pulse velocity test in detail with proper sketches	12	CO3	4
Q.4(a)	a) Polymer Modified Mortars or concrete, b) Polymer bonded mortar, c) Epoxy mortar and d) epoxy concrete, Explain in detail with examples how you will select a repair material out of mentioned above repair materials Name different polymers used as repair material	12	CO4	5
Q.4(b)	Explain behaviour of concrete at different stages as fire temperature increases.	08	CO4	7
Q.5(a)	Write a short note on impressed current cathodic protection (ICCP)	08	CO4	7
Q.5(b)	Explain different methods of controlling corrosion of Embedded Metals by Carbonation and Chloride Induced corrosion	12	CO4	6
Q.6(a)	To address corrosion how Electro chemical repair using cathodic protection is performed. Explain in detail with chemical reaction.	12	CO4	7
Q.6(b)	What precautions need to be taken while conducting condition assessment of fire damaged structure and	08	CO3	4
Q.7(a)	Explain the importance and limitations of chlorine extraction and re-alkalization and how it is performed	10	CO4	7
Q.7(b)	Explain all the causes of deterioration of cementitious system	10	CO2	2



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End Semester Examination/ Re-Examination, May /June 2026

Program: T. Y. B. Tech. Civil

Duration: 3 Hour

Course Code: PE -BTC - 663

Maximum Points: 100

Course Name: Traffic Engineering & Control (Elective)

Semester: VI

Sem-VI

20/7/26

Notes:

- (i) Question 1 is compulsory
- (ii) Solve any four out of remaining six questions
- (iii) Assume suitable data if required
- (iv) Use graph paper if required

Q.No.	Questions	Points	CO	BL	Module
Q.1					
a	Discuss the function of traffic engineering	06	01	01	01
b	Enlist at least 12 Regulatory sign	06	02	01	07
c	Write short notes on (i) z - test and (ii) t- test	08	01	01	02
Q.2.					
	Discuss with and example the term				01
	i. Running speed and Journey speed				
a	ii. Space mean speed and time mean speed	08	02	01	
	The speed observation from radar meter have been taken. Table I, shows the spot speed of various vehicles observed on highway in km/hr. calculate, (i) space mean speed (ii) Time mean speed (iii) Variance and std. deviation about space mean speed	12	01	03	02
Q.3					
a	Discuss field procedure for conducting traffic survey by moving observer method. How will you record the data collected.	08	01	02	01
	The data collected from the speed and delay study by floating car method on a stretch of road of 1.5 km road is given in the table -II; calculate traffic flow and running speed in each direction. Also, calculate journey speed in each direction.	12	02	03	01
Q.4.					
a	Discuss Origin - Destination study	08	02	02	01
	The spot speed study at particular location are normally distributed with a mean of 51.7 km/hr and standard deviation of 8.3 km/hr. What is the probability that;	12	01	03	02
b					



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	(a) Speed exceed 65 km/hr, (b) Speed lie between 40 km/hr and 70 km/hr (c) 85 th percentile speed, (d) 98 th percentile speed.																
Q.5.																	
a	Discuss Benefit/Cost ratio method for economic evaluation of transportation projects	08	02	02	06												
b	The spot speed study is carried out on the link road and western express highway, the data collected and analysed. The mean speed, standard deviation and sample size is shown in table below. Test with the hypothesis that at 5 % level of significance whether there is difference in mean speed. <table><tr><td>Name of Road</td><td>Average mean speed</td><td>Std. Deviation</td><td>Sample size</td></tr><tr><td>Link road</td><td>40</td><td>15.2</td><td>180</td></tr><tr><td>Western Expressway</td><td>45</td><td>11.2</td><td>210</td></tr></table>	Name of Road	Average mean speed	Std. Deviation	Sample size	Link road	40	15.2	180	Western Expressway	45	11.2	210	12	01	03	02
Name of Road	Average mean speed	Std. Deviation	Sample size														
Link road	40	15.2	180														
Western Expressway	45	11.2	210														
Q.6.																	
a	Discuss the factors governing trip generation and trip attraction	05	02	02	04												
b	Explain Manual method for conducting Traffic Volume Study.	05	02	02	04												
c	the self-contained town consist of three residential area, A, B & C and two industrial area, X & Y. the generation equation shows that for the design year in the equation, the trip from home to work generated by each residential area per day are given in table below; <table><tr><td>Residential area</td><td>Trip generated per day</td></tr><tr><td>A</td><td>2250</td></tr><tr><td>B</td><td>1750</td></tr><tr><td>C</td><td>3200</td></tr></table> There are 4000 jobs and 3200 jobs in industrial area X & Y respectively. It is known that the attraction between zones is inversely proportional to square of journey time between zones. The journey time in minutes from residential area to industrial area are shown in table below;	Residential area	Trip generated per day	A	2250	B	1750	C	3200	10	02	03	03				
Residential area	Trip generated per day																
A	2250																
B	1750																
C	3200																



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	Calculate the inter zonal trip from residential area to industrial area using gravity model.																
	<table><tr><th>zone</th><th>X</th><th>Y</th></tr><tr><td>A</td><td>15</td><td>10</td></tr><tr><td>B</td><td>10</td><td>15</td></tr><tr><td>C</td><td>15</td><td>20</td></tr></table>	zone	X	Y	A	15	10	B	10	15	C	15	20				
zone	X	Y															
A	15	10															
B	10	15															
C	15	20															
Q.7.																	
a	Discuss with an example Balance and Unbalanced Transportation problem	08	02		03												
b	The company has three concrete mixing plants A, B and C from which they can supply the concrete. It was decided to purchase the concrete from the company for the construct the cement concrete road. As per demand the concrete to be supply at four destinations D, E, F and G. the maximum capacity of concrete mixing plant A, B and C are 500 m ³ , 2500 m ³ and 1000 m ³ respectively. The amount of demand of concrete at destinations D, E, F and G are 500 m ³ , 1500 m ³ , 1500 m ³ and 1500 m ³ respectively. The unit transportation cost of concrete from sources to destinations are shown in table below. Calculate the initial feasible solution by (i) N – W corner method and (ii) least cost method	12	02		03												



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Q.2.(b), Table – I

25	36	37	19	20	18	50	62	41	45
22	29	40	50	13	18	29	30	49	48
43	39	55	63	59	48	55	57	44	36
39	29	60	43	44	27	23	38	46	50

Q.3.(b), Table – II

Trip No.	Trip direction	Time (min)	Delay (min)	No of vehicles		Vech. form opp. direction
				overtaking	overtaken	
1	N - S	6.32	1.40	4	7	268
2	S - N	7.14	1.50	5	3	186
3	N - S	6.50	1.30	5	3	280
4	S - N	7.40	2.00	2	1	200
5	N - S	6.10	1.10	3	5	250
6	S - N	8.00	2.22	2	2	170
7	N - S	6.28	1.40	2	5	290
8	S - N	7.30	1.40	3	2	160

Q.7. (b) Table – III

	D	E	F	G	Supply
A	5	2	8	20	1500
B	4	7	9	11	2500
C	10	1	15	6	1000
Demand	500	1500	1500	1500	

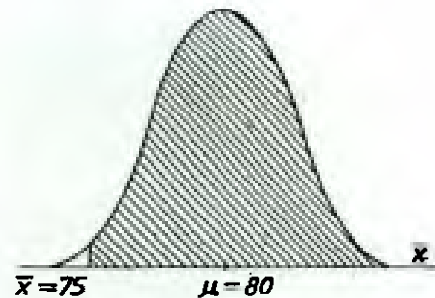


Fig. 8-12

$$\begin{aligned}
 &= 1 - \phi\left(\frac{75 - 80}{1.5}\right) \\
 &= 1 - \phi(-3.33) = 1 - [1 - \phi(3.33)] \\
 &= 1 - 1 + \phi(3.33) = 0.9996, \text{ using Table 8-11.}
 \end{aligned}$$

The probability is 0.9996 that the mean speed of sample of size of 100 vehicles will exceed 75 K.P.H.

8-6-4. Distribution of mean where sampling a non-normal population—Central limit theorem

If the variable x does not possess a normal distribution, what can be predicted about the distribution of $\bar{x}$, the sample mean? It has been found that if the sample size is sufficiently large, say larger than 25, the distribution of $\bar{x}$ will be normal, even though the distribution of x may be non-normal. This principle is known as the "Central limit theorem" and can be stated as follows:

Theorem. If x possess a distribution with mean μ and standard deviation σ , then the sample mean $\bar{x}$, based on a sample of size n , will have a distribution that approaches the distribution of a normal variable with mean μ and standard deviation $\sigma/\sqrt{n}$, as n becomes infinite.

8-6-5. Point estimate and interval estimate

A population can be studied if the parameters of the distribution can be estimated. For example, for a normal distribution, the parameters μ and σ determine the properties of a population, and it will be important to be able to estimate these parameters.

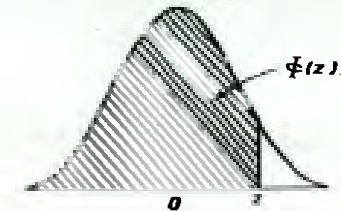
In connection with the estimation of parameters, two types of estimates are in common use: point estimate and interval estimate. A point estimate is a particular value which may be used to estimate the unknown value of a parameter. For example, the sample mean $\bar{x}$ is

a point estimate of the population mean μ . A point estimate has its own limitations, because even the best point estimate may be considerably away from the parameter and a single value may not be deemed satisfactory. Thus, it is more usual to estimate a parameter within an interval, determined by two numbers obtained to contain the value of the parameter within the bounds of the two values. Thus, if t_1 and t_2 are two values of a random variable t and it is desired to estimate the parameter θ , then

$$P[t_1 \leq \theta \leq t_2] = \gamma \quad \dots (8-29)$$

where γ is some specified probability. In other words, it can be said that the probability of θ lying in the interval bounded by two values

Table 8-11



The Normal Distribution Function

z	$\phi(z)$	z	$\phi(z)$	z	$\phi(z)$
0.00	0.5000	0.35	0.6368	0.70	0.7580
0.01	.5040	0.36	.6406	0.71	.7611
0.02	.5080	0.37	.6443	0.72	.7642
0.03	.5120	0.38	.6480	0.73	.7673
0.04	.5160	0.39	.6517	0.74	.7704
0.05	.5199	0.40	.6554	0.75	.7734
0.06	.5239	0.41	.6591	0.76	.7764
0.07	.5279	0.42	.6628	0.77	.7794
0.08	.5319	0.43	.6664	0.78	.7823
0.09	.5359	0.44	.6700	0.79	.7852
0.10	.5398	0.45	.6736	0.80	.7881
0.11	.5438	0.46	.6772	0.81	.7910
0.12	.5478	0.47	.6808	0.82	.7939
0.13	.5517	0.48	.6844	0.83	.7967
0.14	.5557	0.49	.6879	0.84	.7995
0.15	.5596	0.50	.6915	0.85	.8023
0.16	.5636	0.51	.6950	0.86	.8051
0.17	.5675	0.52	.6985	0.87	.8078
0.18	.5714	0.53	.7019	0.88	.8103
0.19	.5753	0.54	.7054	0.89	.8133
0.20	.5793	0.55	.7088	0.90	.8159
0.21	.5832	0.56	.7123	0.91	.8186
0.22	.5871	0.57	.7157	0.92	.8212
0.23	.5910	0.58	.7190	0.93	.8238
0.24	.5948	0.59	.7224	0.94	.8264

TRAFFIC ENGINEERING AND TRANSPORT PLANNING

z	$\phi(z)$	z	$\phi(z)$	z	$\phi(z)$
0.25	0.5987	0.60	0.7257	0.95	0.8289
.26	.6026	.61	.7291	.96	.8315
.27	.6064	.62	.7324	.97	.8340
.28	.6103	.63	.7357	.98	.8365
.29	.6141	.64	.7389	.99	.8389
0.30	0.6179	0.65	0.7422	1.00	0.8413
.31	.6217	.66	.7454	.01	.8438
.32	.6255	.67	.7486	.02	.8461
.33	.6293	.68	.7517	.03	.8485
.34	.6331	.69	.7549	.04	.8508
1.05	0.8531	1.55	0.9394	2.05	0.97982
.06	.8554	.56	.9406	.06	.98030
.07	.8577	.57	.9418	.07	.98077
.08	.8599	.58	.9429	.08	.98124
.09	.8621	.59	.9441	.09	.98169
1.10	.8643	1.60	0.9452	2.10	0.98214
.11	.8665	.61	.9463	.11	.98257
.12	.8686	.62	.9474	.12	.98300
.13	.8708	.63	.9484	.13	.98341
.14	.8729	.64	.9495	.14	.98382
1.15	0.8749	1.65	0.9505	2.15	0.98422
.16	.8770	.66	.9515	.16	.98461
.17	.8790	.67	.9525	.17	.98500
.18	.8810	.68	.9535	.18	.98537
.19	.8830	.69	.9545	.19	.98574
1.20	0.8849	1.70	0.9554	2.20	0.98610
.21	.8869	.71	.9564	.21	.98645
.22	.8888	.72	.9573	.22	.98679
.23	.8907	.73	.9582	.23	.98723
.24	.8925	.74	.9591	.24	.98745
1.25	0.8944	1.75	0.9599	2.25	0.98778
.26	.8962	.76	.9608	.26	.98809
.27	.8980	.77	.9616	.27	.98840
.28	.8997	.78	.9625	.28	.98870
.29	.9015	.79	.9633	.29	.98899
1.30	0.9032	1.80	0.9641	2.30	0.98928
.31	.9049	.81	.9649	.31	.98956
.32	.9066	.82	.9656	.32	.98983
.33	.9082	.83	.9664	.33	.99010
.34	.9099	.84	.9671	.34	.99036
1.35	0.9115	1.85	0.9678	2.35	0.99061
.36	.9131	.86	.9686	.36	.99086
.37	.9147	.87	.9693	.37	.99111
.38	.9162	.88	.9699	.38	.99134
.39	.9177	.89	.9706	.39	.99158

z	$\phi(z)$	z	$\phi(z)$	z	$\phi(z)$
1.40	0.9192	1.90	0.9713	2.40	0.99180
.41	.9207	.91	.9719	.41	.99202
.42	.9222	.92	.9726	.42	.99224
.43	.9236	.93	.9732	.43	.99245
.44	.9251	.94	.9738	.44	.99266
1.45	0.9265	1.95	0.9744	2.45	0.99286
.46	.9279	.96	.9750	.46	.99305
.47	.9292	.97	.9756	.47	.99324
.48	.9306	.98	.9761	.48	.99343
.49	.9319	.99	.9767	.49	.99361
1.50	0.9332	2.00	0.97725	2.50	0.99379
.51	.9345	.01	.97778	.51	.99396
.52	.9357	.02	.97831	.52	.99413
.53	.9370	.03	.97882	.53	.99430
.54	.9382	.04	.97932	.54	.99446
2.55	0.99461	2.75	0.99702	2.95	0.99841
.56	.99477	.76	.99711	.96	.99846
.57	.99492	.77	.99720	.97	.99851
.58	.99506	.78	.99728	.98	.99856
.59	.99520	.79	.99736	.99	.99861
2.60	0.99534	2.80	0.99744	3.00	0.99865
.61	.99547	.81	.99752	.10	.99903
.62	.99560	.82	.99760	.20	.99931
.63	.99573	.83	.99767	.30	.99952
.64	.99585	.84	.99774	.40	.99966
2.65	0.99598	2.85	0.99781	3.50	0.99977
.66	.99609	.86	.99788	.60	.99984
.67	.99621	.87	.99795	.70	.99989
.68	.99632	.88	.99801	.80	.99993
.69	.99643	.89	.99807	.90	.99995
2.70	0.99653	2.90	0.99813	4.00	0.99997
.71	.99664	.91	.99819		
.72	.99674	.92	.99825		
.73	.99683	.93	.99831		
.74	.99693	.94	.99836		

t_1 and t_2 is γ . The set of values between t_1 and t_2 inclusive is called the confidence interval of θ . The values of t_1 and t_2 are called the confidence limits. The probability measure γ in the probability equation (8-29) is called the confidence level. The confidence interval is also referred to as 100 γ per cent confidence interval.

The confidence level of an interval estimate for a parameter is the proportion of the samples for which the interval includes the true value.

Table 2: Critical Values of Student's *t*-Distribution

d.f.	Level of significance for two-tailed test					d.f.
	0.20	0.10	0.05	0.02	0.01	
	Level of significance for one-tailed test					
	0.10	0.05	0.025	0.01	0.005	
1	3.078	6.314	12.706	31.821	63.657	1
2	1.886	2.920	4.303	6.965	9.925	2
3	1.638	2.353	3.182	4.541	5.841	3
4	1.533	2.132	2.776	3.747	4.604	4
5	1.476	2.015	2.571	3.365	4.032	5
6	1.440	1.943	2.447	3.143	3.707	6
7	1.415	1.895	2.365	2.998	3.499	7
8	1.397	1.860	2.306	2.896	3.355	8
9	1.383	1.833	2.262	2.821	3.250	9
10	1.372	1.812	2.228	2.764	3.169	10
11	1.363	1.796	2.201	2.718	3.106	11
12	1.356	1.782	2.179	2.681	3.055	12
13	1.350	1.771	2.160	2.650	3.012	13
14	1.345	1.761	2.145	2.624	2.977	14
15	1.341	1.753	2.731	2.602	2.947	15
16	1.337	1.746	2.120	2.583	2.921	16
17	1.333	1.740	2.110	2.567	2.898	17
18	1.330	1.734	2.101	2.552	2.878	18
19	1.328	1.729	2.093	2.539	2.861	19
20	1.325	1.725	2.086	2.528	2.845	20
21	1.323	1.721	2.080	2.518	2.831	21
22	1.321	1.717	2.074	2.508	2.819	22
23	1.319	1.714	2.069	2.500	2.807	23
24	1.318	1.711	2.064	2.492	2.797	24
25	1.316	1.708	2.060	2.485	2.787	25
26	1.315	1.706	2.056	2.479	2.779	26
27	1.314	1.703	2.052	2.473	2.771	27
28	1.313	1.701	2.048	2.467	2.763	28
29	1.311	1.699	2.045	2.462	2.756	29
Infinity	1.282	1.645	1.960	2.326	2.576	Infinity