S.Y. B.Tech Civil Sem III END Sem Feb26

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

END SEMESTER ~~December 2025~~ / ~~RE~~ - EXAM February 2026

Program: Civil Second year civil working Prof. **Duration:3 hours**

Course Code: BS-BTC301 **Maximum Points:100**

Course Name:Laplace linear algebra and complex analysis **Semester:III**

Notes: 1)Attempt any 5 out of 7 questions.

2) Use of scientific calculator is allowed.

19/01/2026

Q.No.	Questions	Points	CO	BL	Module No.
Q1a	Evaluate Laplace transform of $f(t) = \sin^3 t$	10	1	1,2,3	1
Q1b	Define a unitary matrix. if $N = \begin{bmatrix} 0 & 1+2i \\ -1+2i & 0 \end{bmatrix}$ is a matrix, then show that $(I-N)(I+N)^{-1}$ is a unitary matrix, where I is an identity matrix.	10	3	1,2,3	4
Q2a	Find the rank of $\begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$	10	3	1,2,3	4
Q2b	Evaluate $\mathcal{L}\{\sin 2t \sin 4t \sinh t\}$	10	1	1,2,3	1
Q3a	Show that $\mathcal{L}\{t^2 \sin t\} = \frac{6S^2 - 2}{(S^2+1)^3}$	10	1	1,2,3	1
Q3b	Find non – singular matrices P, Q so that PAQ is a normal form where $A = \begin{bmatrix} 2 & 1 & -3 & -6 \\ 3 & -3 & 1 & 2 \\ 1 & 1 & 1 & 2 \end{bmatrix}$	10	3	1,2,3	5
Q4a	Evaluate $\mathcal{L}\left\{\int_0^t te^{-3t} \sin 4t \, dt\right\}$	10	1	1,2,3	1

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END SEMESTER ~~December 2025~~ / ~~RE~~ - EXAM February 2026

Q4b	Show that the equations $2x+6y=-11, 6x+20y-6z=-3, 6y-18z=-1$ are not consistent.	10	3	1,2,3	4
Q5a	Prove that $\int_0^\infty e^{-t}\frac{\sin^2 t}{t}dt=\frac{1}{4}\log 5$	10	1	1,2,3	2
Q5b	Find the values and eigen vectors of the matrix. $A=\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$	10	3	1,2,3	5
Q6a	Solve $y''+y=t$ Given $y(0)=1$ $y'(0)=-2$ using laplace	10	1	1,2,3	2
Q6b	Evaluate: $\mathcal{L}^{-1}\left\{\log\left(1+\frac{1}{s^2}\right)\right\}$	10	1	1,2,3	2
Q7a	Verify Cayley-Hamilton's theorem for $A=\begin{bmatrix} 1 & 2 & 4 \\ -1 & 0 & 3 \\ 3 & 1 & -2 \end{bmatrix}$ & hence obtain A^{-1}	10	3	1,2,3	5
Q7b	Prove that: $\mathcal{L}^{-1}\left\{\frac{1}{(s^2+a^2)^2}\right\}=\frac{1}{2a^3}(\sin at-at\cos at)$ using convolution theorem	10	1	1,2,3	2

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END SEMESTER ~~December 2025~~ / ~~RE~~ - EXAM February 2026

Program: Civil Second year Civil working Prof. **Duration:3 hours**

Course Code: BS-BTC301 **Maximum Points:100**

Course Name:Laplace linear algebra and complex analysis **Semester:III**

Notes: 1)Attempt any 5 out of 7 questions.

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19/01/2026

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END SEMESTER ~~December 2025~~ / ~~RE~~ - EXAM February 2026

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End Semester Exam/~~Re-exam~~ – January/~~February~~ 2026

Program: B.Tech Civil Engineering (WP) **Duration: 3 hours**

Course Code: PC-BTC301 **Maximum Points:100**

Course Name: Mechanics of materials **Semester:III**

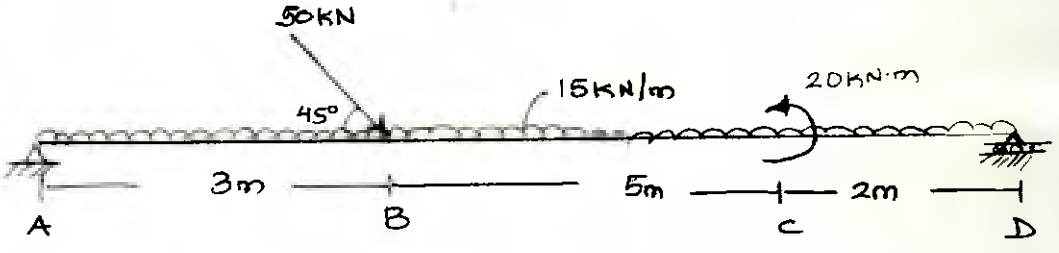
Notes : ***Attempt any 5 main questions out of 7; Assume any missing data and state the same clearly; Illustrate your answers with neat sketches***

20/01/2026

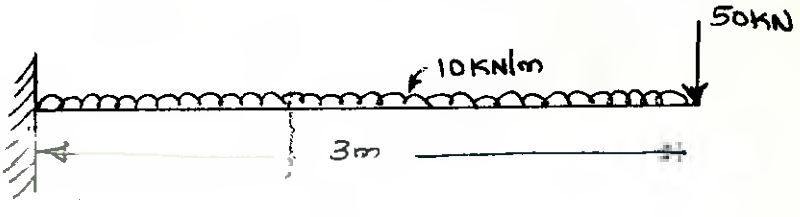
Q.No.	Questions	Points	CO	BL	Modul No.
1.a)	Three rods made of different materials are rigidly joined end to end to form a single straight bar. The first rod is made of steel, 400 mm long with a cross-sectional area of 350 mm². The second rod is made of aluminium, 700 mm long with a cross-sectional area of 500 mm². The third rod is made of brass, 600 mm long with a cross-sectional area of 450 mm². The assembly is subjected to an axial tensile force of 150 kN acting uniformly through the length of the bar. Modulus of elasticity of steel = 2.0×10^5 MPa, Modulus of elasticity of aluminium is 0.7×10^5 MPa Modulus of elasticity of brass is 1.0×10^5 MPa, Evaluate (i) the stress developed in each rod (ii) the extension of each rod (iii) the total elongation	10	02	03	01
1.b)	A compound tube consists of an inner steel tube having an internal diameter of 160 mm and an external diameter of 175 mm, and an outer aluminium tube having an internal diameter of 185 mm and an external diameter of 200 mm. Both tubes are 1.5 m long and are rigidly fastened together at both ends. The compound tube is subjected to an axial compressive load of 900 kN. Determine: (i) the change in length (ii) the stresses developed in the steel tube and aluminium tube (iii) the load carried by each tube	10	02	04	01
2.a)	A steel rod 2.5m long is initially at a temperature of 80°C. Determine: i) Free expansion/contraction and the corresponding stress when the temperature falls to 20°C ii) Stress developed if the expansion/contraction is completely prevented	10	02	03	01

End Semester Exam/~~Re-exam~~ – January/~~February~~ 2026

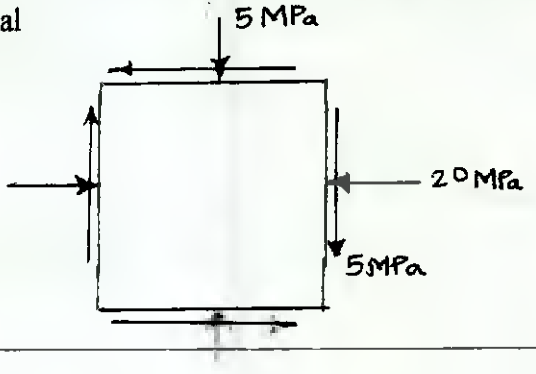
	iii) Stress produced if the permitted expansion/contraction is 0.5 mm Take $\alpha = 12 \times 10^{-6}/^0$ C, E = 200×10^3 MPa.				
2.b)	During a tensile test on a mild steel specimen of 22 mm diameter, an axial load of 50 kN produces an elongation of 0.085 mm over a gauge length of 120 mm. The corresponding reduction in diameter is observed to be 0.004 mm. Determine: (i) Poisson's ratio of the material (ii) Young's modulus (E) (iii) Modulus of rigidity (G) (iv) Bulk modulus (K) Explain the significance of determining these material properties for engineering applications	10	02	04	01
3.a)	Draw the shear force, bending moment and axial force diagram for the beam shown below. Also find the maximum value of bending moment.	15	01	04	02



3.b)	Draw the shear force and bending moment for the cantilever beam shown below. Also find the maximum value of bending moment.	05	01	04	



4.a)	A rectangular timber beam of size 320 mm × 650 mm is strengthened by fixing two steel plates each of size 12 mm × 580 mm on its vertical sides. The composite beam is simply supported over a span of 6 m and carries a uniformly distributed load of 14	12	02	04	03

	kN/m over the entire span. Determine the bending stresses developed in the steel plates and in the timber at the centre of the span. $E_s = 2 \times 10^5$ N/mm^2, $E_t = 1.0 \times 10^4$ N/mm^2				
4.b)	A thin cylindrical shell with closed ends is made of a steel plate 3 mm thick. The internal diameter of the cylinder is 500 mm and the length is 1.5 m. The vessel is subjected to an internal pressure of 4.2 N/mm^2. Determine the longitudinal and hoop stresses in the cylindrical shell. Also calculate the increase in length, diameter and volume of vessel. Take E = 2×10^5 N/mm^2 and μ=0.31	08	03	03	07
5.a)	A plane element is subjected to the stresses as shown in the figure below. Determine analytically: i) The principal stresses and their directions ii) The maximum shearing stresses and the directions of the plane in which they act. iii) Normal and shearing stresses on the inclined plane P-P having a normal inclined at 30^0 anticlockwise to the horizontal 	10	02	04	06
5.b)	Solve Q.5.a) using Mohr's circle	10	02	04	06
6.a)	A simply supported I-section beam consists of: Top flange and bottom flange = 150 mm × 15 mm Web = 300 mm × 10 mm The beam carries a uniformly distributed load of 15 kN/m over a span of 5 m. Evaluate and sketch the shear stress distribution across the depth of the section at mid-span.	10	02	03	04
6.b)	A channel section has a web of 300 × 10 mm and two flanges each 250 × 12 mm. The section is subjected to a vertical shear force of 30 kN. Determine the position of the shear centre of the section.	10	04	03	04
7.a)	A solid circular shaft is required to transmit a torque of 15 kN·m. The maximum permissible shear stress is 85 MPa, and the angle of twist should not exceed 0.8° per metre length. Take G = 80 GPa. i) Determine the diameter of the solid shaft	10	02	04	05

End Semester Exam/~~Re-exam -~~ January/~~February~~ 2026

	ii) If the solid shaft is replaced by a hollow shaft of the same material and length, with internal diameter equal to 0.7 times the external diameter, find the dimensions of the hollow shaft.				
7.b)	With the help of stress-strain curve for mild steel explain the following terms: Proportional limit; Elastic limit; Yield stress; Ultimate stress Explain the difference between ductile and brittle materials in terms of failure surfaces and nature of stress strain curve.	10	02	03	01

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END SEMESTER December 2025 / ~~RE – EXAM February 2026~~

Program: S.Y. B. Tech Working Professionals Civil Engg.
Course Code: BS-BTC302
Course Name: Engineering Geology

Duration: 3 hours
Maximum Points: 100
Semester: III

21/01/2026

Notes:
Question 1 is compulsory
Attempt and FOUR questions from the remaining SIX questions
Attach the stratigraphic correlation sheet to the ANSWER SHEET.

Q. No.	Questions	Points	CO	BL	Module No.
1	a. Explain the term weathering and what are types of physical weathering. b. Write a brief note on any 5 of the following 1. Rheological classification of the Earth 2. Mantle of the Earth 3. Types of moraines 4. Yardangs and Zeugen 5. Any two aeolian depositional features 6. Surface Caverns	10 + 10	1	2	1
2	a. Write a short note on Primary and secondary minerals b. Write a one-line description on any SIX forms/habit of minerals. c. Match the following:	4 + 6 + 10	1,2	2,3	2

1. Overburden	a. Discarded material
2. Copper ore	b. Magnetite
3. Gangue	c. Cassiterite
4. Iron ore	d. Pyrolusite
5. Aluminum ore	e. Chromite
6. Manganese ore	f. Galena
7. Lead ore	g. Sphalerite
8. Tin ore	h. Overlying material
9. Chromium ore	i. Malachite
10. Zinc ore	j. Bauxite

END SEMESTER December 2025 / ~~RE - EXAM February 2026~~

3	a. Explain the following. 1. Types of metamorphism 2. Structures in metamorphic rocks. b. Discuss in-short the formation of igneous rocks and write a short note on any 4 common igneous rocks. Name the igneous rock which is commonly found in Maharashtra	10 + 10	1	2	3
4	a. If you are working in an igneous terrain what are various engineering properties of igneous rock you will consider? b. How are sedimentary rocks classified, explain with the help of suitable examples. Imagine there are two sites with different lithologies, one which sandstone terrain while other with terrain showing Karst formation, which terrain will be suitable for construction according to you. c. Discuss any five properties of sedimentary rocks.	10 + 5 + 5	2	3, 4	3
5	a. What is a geological structure where rocks moves along the fracture discontinuity, also explain it types along with a neat diagram. b. Draw the stratigraphic correlation in the given diagram and tell whether the rock in the diagrams are igneous, sedimentary or metamorphic	10 + 10	2.3	3,4	4
6	a. A detailed short note on Principles of Stratigraphy b. Define the following terms related to fold 1. Hinge 2. Limbs 3. Axial plane 4. Fold axis	12 + 8	1	1,2	4
7	a. Define the following also state their respective formulae: 1. Specific gravity 2. Porosity 3. Sorption b. Calculate the RQD for the following core samples and state comment on its quality: Total drill length= 250 m Length of core pieces= 15 cm, 88 mm, 32 mm, 28 cm, 66 mm, 71 mm, 20 cm, 21 cm, 58 cm, 75 mm, 27 cm, 67 cm, 45 mm.	20 6 + 6 + 8	2,3	4	5

END SEMESTER December 2025 / ~~RE – EXAM February 2026~~

	c. If you are assigned to construct a tunnel, what all ideal geological conditions will you prefer as a civil engineer to start the construction				

END

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END SEM/RE-EXAM EXAMINATION DEC/JAN 2025-26–

Program: Civil Engineering Second year Civil W.P
Course Code: PC-BTC-303
Course Name: Building Drawing with CAD

Duration: 3.00 hrs.
Maximum Points: 100
Semester: III (WP)

22/01/2026

Notes: 1. Q.1 is compulsory & attempts any four out of remaining six.
2. Illustrate answer with neat sketches wherever required.
3. Make suitable assumptions where necessary and state them clearly.

Q.No.	Questions	Points	BL	CO	Module No
1.	A) Draw to a suitable scale developed plan for ground floor of G+1 story bungalow on a site of the data given below. 1. Plot size: 14 M x 16 M. (FSI: 1.0) 2. Road is on south side parallel to 14 M direction 3. Wind direction is E-SW-W & climatic zone is cold. 4. Requirements of Engineer a. Office room b. Master bed room c. Living room d. Children bed room e. Kitchen cum dining room f. Guest bed room g. Staircase/bath/WC/store/verandah are to be provided	20	L4	1-5	1-5
2	A. Draw to a suitable scale elevation for Q.1A. B. State: Built up area, Rera carpet area, carpet area, super built up area, FSI for Q.1A.	15+05	L2	1-5	1/5
3	A. Draw to a suitable scale, line plan of POST OFFICE building opening on a plot size 30 M x 35 M. Show all units with dimension and position of door, & windows.	20	L3	2-5	1,2
4	A. Discuss the need, objectives and five pillars of Real Estate Regulation Act, 2016 (RERA). B. Explain following principles of planning in detail, 1. Aspect 2. Circulation	10+10	L2	2	1
5	A. What do you mean by building bye laws? Discuss the objectives of building byelaws. Also discuss the open space, minimum plot size and building frontage. B. Differentiate between load-bearing structures and framed structures, with suitable examples and diagrams.	10+10	L2/3	2-5	1/3/5

6	A. Draw to a suitable scale Terrace plan for Q.1A. B. Draw to a suitable scale site plan for Q.1A.	05+15	L3	1-3	1/3/5
7	A. Discuss any five climatic factors influencing the planning of residential building ,with examples/diagrams. B. Discuss the types of residential building along with advantages and disadvantages.	10+10	L3	1-3	1/3/5

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End Sem Exam /~~Re-Exam Jan~~ 2026 Jan

Program: Civil Engineering (Working Professional) **Duration: 3 hours**

Course Code: PC-3BTC304 **Maximum Points: 100**

Course Name: Fluid Mechanics **Semester: 3**

Instructions:

23/01/26

1. **Question number 1 is compulsory**
2. **Attempt any 4 questions out of remaining 6 questions**
3. **Assume suitable data if needed and mention it clearly**
4. **Neat diagrams must be drawn wherever necessary.**
5. **Figures to the right indicate marks**

.No.	Questions	Points	CO	BL	Mod No
Q.1	Attempt any **FOUR of the following**				
a	Enlist the different types of fluid flow with suitable equations	5	CO4	BL2	4
b	State and prove Pascal's Law	5	CO2	BL2	2
c	Brief about the different pressure measuring devices	5	CO2	BL1	2
d	Calculate the capillary effect when a glass tube of 3 mm diameter is immersed in water, will there be a rise or fall in tube. Justify your answer.	5	CO1	BL3	1
e	Differentiate between stream lines and path lines	5	CO4	BL2	4
f	State the experimental equation for determination of metacentric height. Also explain the terms in the equation		CO3	BL2	3
Q.2a	A rectangular plane 3.0m wide and 5.0 m deep is immersed in water in such a way that its plane makes an angle of 40 degrees with the free surface. Determine the total pressure on one face of the plate and position of the center of pressure when its upper edge is 2.5 m below the free surface.	10	CO3	BL3	3
Q.2b	A fluid flow field is given by $V = x^2yi + y^2zj - (2xy + yz^2)k$, prove that it satisfies continuity equation, also calculate the velocity and acceleration at point (2, 1, 3) and time t = 4 sec	10	CO3	BL3	3
Q.3a	A cylinder of 0.30 m diameter rotates concentrically inside a fixed cylinder of 0.31 m diameter. Both cylinders are 0.30 m long. Determine the viscosity of the fluid which fills the space between the cylinders if a torque of 0.98 Nm is required to maintain a speed of rotation of 60 rpm	10	CO1	BL3	1
Q.3b	A rectangular pontoon is 5 m long, 3 m wide and 1.20 m high. The depth immersion of the pontoon is 0.80 m in sea water. If the center of gravity is 0.6 m above the bottom of the pontoon, determine the meta-centric height. The density for sea water = 1025 kg/m³.	10	CO3	BL3	3
Q.4a	Derive the general form of continuity equation, A pipe, through which water flows, has diameters, 20 cm and 10 cm at the cross-sections 1 and 2	10	CO4	BL3	4

End Sem Exam /~~Re-Exam~~ Jan 2026

	respectively. The velocity of water at section I is given 4.0 m/s. Find the volume flow rate.				
Q.4b	What is the pressure in terms of gauge and absolute within a droplet of water 0.05 mm in diameter at 20^0 C, if the pressure outside the droplet is standard atmospheric pressure, if the surface tension σ = 0.0075 N/m for water. Consider atmospheric pressure as 101325 N/m2Tank A contains oil, which is compressed using a cylinder, when the pressure in A was increased from 800 Pa to 1200 Pa the change in mass density was 1.5 kg/m3. Determine the Bulk modulus of this fluid, Assume density of oil 850 kg/m3	10	CO1	BL3	1
Q.5a	A rectangular tank 4 m long, 1.5 m wide contains three liquids , with their details as per following Fluid A Specific gravity 1.0 , height in tank 1.2 m Fluid B Specific gravity 0.8 , height in tank 1.5 m Fluid C Specific gravity 1.2, height in tank 1.0 m Sketch the tank and Determine: The total pressure intensity, Total pressure force and center of pressure on one side	10	CO2	BL3	2
Q.5b	A horizontal venturimeter with inlet diameter 300 mm and throat diameter 150 mm is employed to measure the flow of water. The reading of the differential manometer connected shows a deflection of 200 mm of mercury. If the Cd = 0.98, determine the rate of flow. Also determine the difference of pressure heads between inlet and throat section	10	CO4	BL3	4
Q.6a	A rectangular plate surface area 4.8 m^2 thickness 26 mm slides down an inclined surface which makes an angle of 40 degree with vertical at a uniform velocity of 2.75 m/s. If the 2.5 mm gap between the plate and inclined surface is filled with oil, determine the viscosity of oil.	8	CO1	BL3	1
Q.6b	A diver working at a depth of 20 m below sea level, calculate the gauge pressure intensity at this depth, also what would be the absolute pressure if atmospheric pressure is 755 mm of mercury column. Take specific gravity of sea water 10 kN/m^2	8	CO2	BL3	2
Q.6c	Sketch the diagram showing atmospheric, absolute, gauge and vacuum pressure	4	CO2	BL3	2
Q.7a	Differentiate between rolling and pitching also suggest which is dangerous with respect to ship design	6	CO3	BL2	3
Q.7b	Water is flowing through a taper pipe of 100 m length having diameters 600 mm at upper end and 300 mm at the lower end at a rate of 50 Lps. The pipe has a slope of 1 in 30, find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm2, neglect any losses	7	CO4	BL3	4
Q.7c	Derive Eulers equation for steady , incompressible flow. And explain the terms in Bernoulli's equation	7	CO4	BL2	4

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END SEM/RE-EXAM EXAMINATION for Working Professionals

JAN/FEB 2025-26

27/01/2026

Second Year

Program: B.Tech. Civil Engineering working Prof Duration: 3 Hour

Course Code : PC-BTC305 Maximum points: 100

Course Name : Concrete Technology Semester: III

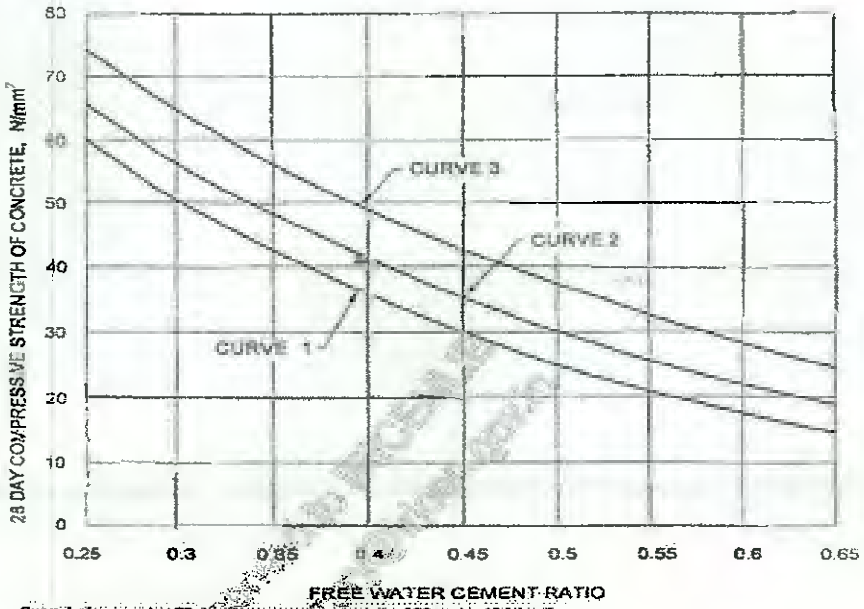
Instructions:

1. Attempt ***any FIVE questions out of SEVEN*** questions
2. Answers to all sub questions should be grouped together
3. Draw neat diagrams wherever required
4. Assume suitable data if necessary and state the clearly.

<table>
<tr><th>Que. No.</th><th>Descriptions</th><th>Points</th><th>CO</th><th>BL</th><th>Module No.</th></tr>
<tr><td>Q1</td><td>(a) State the purpose concrete compaction. Explain various methods of compaction of concrete with their suitability.
(b) Explain in detail the situation for conducting load test on concrete.
(c) Discuss the advantages and disadvantages of light weight concrete.</td><td>10
04
06</td><td>3
4
1</td><td>4
3
2</td><td>03
05
01</td></tr>
<tr><td rowspan="2">Q2</td><td>a. Differentiate between artificial and natural aggregate</td><td>5</td><td>1</td><td>3</td><td>01</td></tr>
<tr><td>b. Design concrete for M50 grade using guidelines given in IS 10262:2019 for the following data.
<table>
<tr><td>Exposure condition: Severe</td><td>Maximum size of aggregate —20 mm</td><td>Method of placement – Pumping</td><td>Specific gravity of 20 mm aggregate (M_2)- 2.70</td></tr>
<tr><td>Strength of cement OPC —53 grade</td><td>Workability — slump, 150 mm</td><td>Type of coarse aggregate — angular coarse aggregate</td><td>Specific gravity of 10 mm aggregate (M_1) — 2.70</td></tr>
<tr><td>Zone of sand — III</td><td>Water absorption- M_2-1.3% & M_1- 1.5%
Total moisture content M_2-0.4% & M_1- 0.5%</td><td>Water absorption fine aggregate- 4.2 %
Total moisture content in fine aggregate – 2.5%</td><td>Specific gravity of fine aggregate — 2.90</td></tr>
</table></td><td>15</td><td>2</td><td>2</td><td>03</td></tr>
<tr><td>Q3</td><td>(a) Design concrete for M 20 grade using DOE method. Refer the data from Que2 and chart attached at the end of manuscript. Consider maximum permissible ratio of 0.60 and minimum cement content as 325 kg per cum (Assume % passing of fine aggregate from 600 micron =40%).
(b) What are the types of chemical admixture used in construction?</td><td>12
08</td><td>2
4</td><td>4
2</td><td>3
4</td></tr>
</table>

Q4	(a) Design a Non-air entrained concrete exposed to ***sea water*** of for M30 grade using ACI Method. Consider following data: OPC 53 grade cement, F.M. of fine Aggregate= 2.6; workability (Slump) = 100 mm, Maximum aggregate size-20 mm and bulk density of coarse Agg. = 1650 kg/m^3. Coarse Aggregates-Water absorption- M_2-1.3% & M_1- 1.5%; moisture content M_2-0.6% & M_1- 0.55%. Water absorption in ***fine aggregate***- 3.5 %, ***moisture content-2.7%.*** (b) Discuss the benefits of High Performance concrete. (c) What are the problem occurs in concrete due to Alkali Silica Reaction?	12 05 03	2 3 3	3 3 2	3 1 1
Q5	(a) It is proposed to **design SCC** of grade M35 using OPC 53 grade cement for slump of 250 mm and slump flow of 700 mm, consider w/c of 0.35. Suggested to use viscosity modifying admixture of 1.1% by weight of cement to reduce water Appx.25%; consider the percentage of fine aggregate passing from 125 micron as 3.95 %. (b) What are the different ways of concrete curing, explain with their suitability.	**10** **10**	1 3	2 2	4 1,3
Q6	(a) Describe in detail the various processes involved in production of Ready mix Concrete. (b) How UPV and Rebound hammer test help to assess the onsite concrete quality? (c) Explain types of pore in concrete.	**10** **06** **04**	3 1 1	2 3 2	4 5 1
Q7	a) Explain the effect of size, shape and texture of fine and coarse aggregates on the properties concrete. b) Explain in detail the reaction mechanism of plasticizer with cement. Write explanatory notes on the following ***(any two)*** i) Fly ash ii) Concrete pump iii) Type of vibrators used in concrete	06 **04** **5** **5** **5**	2 2 3 1 1	3 3 2 2 2	1 1 1 1 1

Reference Tables for IS 10262:2019 Method of Concrete mix design



Curve 1 : for expected 28 days compressive strength of 33 and < 43 N/mm².
Curve 2 : for expected 28 days compressive strength of 43 and < 53 N/mm².
Curve 3 : for expected 28 days compressive strength of 53 N/mm² and above.

NOTES

Table 5 Minimum Cement Content, Maximum Water-Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum Size

(Clauses 6.1.2, 8.2.4.1 *and* 9.1.2*)*

Sl No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild	220	0.60	–	300	0.55	M 20
ii)	Moderate	240	0.60	M 15	300	0.50	M 25
iii)	Severe	250	0.50	M 20	320	0.45	M 30
iv)	Very severe	260	0.45	M 20	340	0.45	M 35
v)	Extreme	280	0.40	M 25	360	0.40	M 40

NOTES

1 Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in 5.2. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolana and slag specified in IS 1489 (Part 1) and IS 455 respectively.

2 Minimum grade for plain concrete under mild exposure condition is not specified.

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Table 5 Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate for Water-Cement/Water-Cementitious Materials Ratio of 0.50

(Clause 5.5*)*

Sl No.	Nominal Maximum Size of Aggregate mm	Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate			
		Zone IV	Zone III	Zone II	Zone I
(1)	(2)	(3)	(4)	(5)	(6)
i)	10	0.54	0.52	0.50	0.48
ii)	20	0.66	0.64	0.62	0.60
iii)	40	0.78	0.72	0.71	0.69

NOTES

1 Volumes are based on aggregates in saturated surface dry condition.

2 These volumes are for crushed (angular) aggregate and suitable adjustments may be made for other shape of aggregate

3 Suitable adjustments may also be made for fine aggregate from other than natural sources, normally, crushed sand or mixed sand may need lesser fine aggregate content. In that case, the coarse aggregate volume shall be suitably increased.

4 It is recommended that fine aggregate conforming to Grading Zone IV, as per IS 383 shall not be used in reinforced concrete unless tests have been made to ascertain the suitability of proposed mix proportions.

Table 4 Water Content per Cubic Metre of Concrete For Nominal Maximum Size of Aggregate

(Clause 5.3*)*

Sl No.	Nominal Maximum Size of Aggregate mm	Water Content[b] kg
(1)	(2)	(3)
i)	10	208
ii)	20	186
iii)	40	165

[b] Water content corresponding to saturated surface dry aggregate

Table 3 Approximate Air Content

(Clause 5.2*)*

Sl No.	Nominal Maximum Size of Aggregate mm	Entrapped Air, as Percentage of Volume of Concrete
(1)	(2)	(3)
i)	10	1.5
ii)	20	1.0
iii)	40	0.8

5.2.1 The actual values of air content can also be adopted during mix proportioning, if the site data (at least 5 results) for similar mix is available.

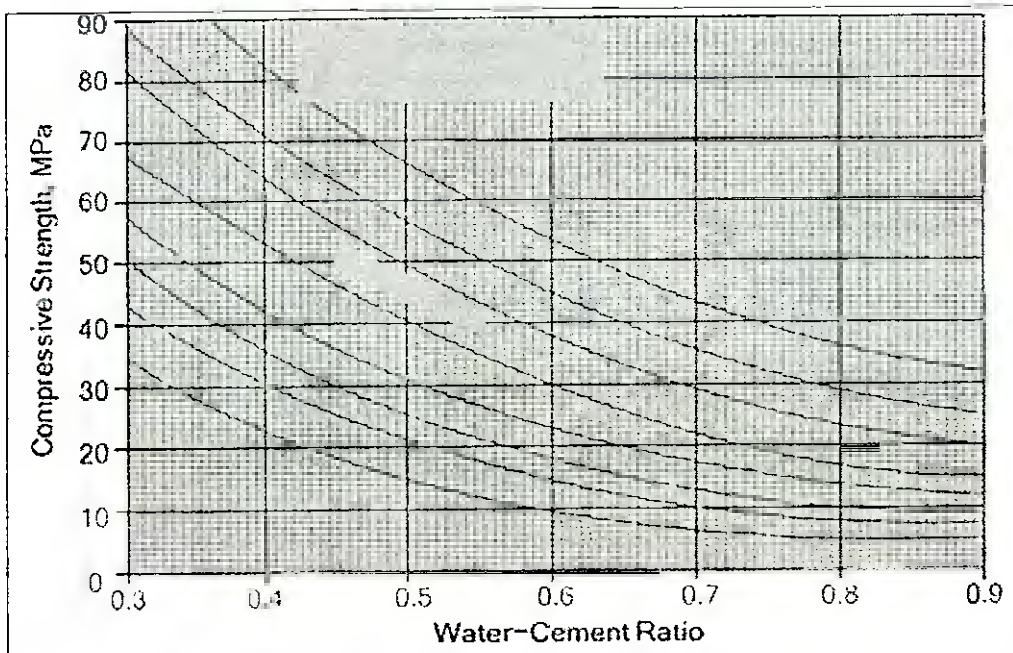
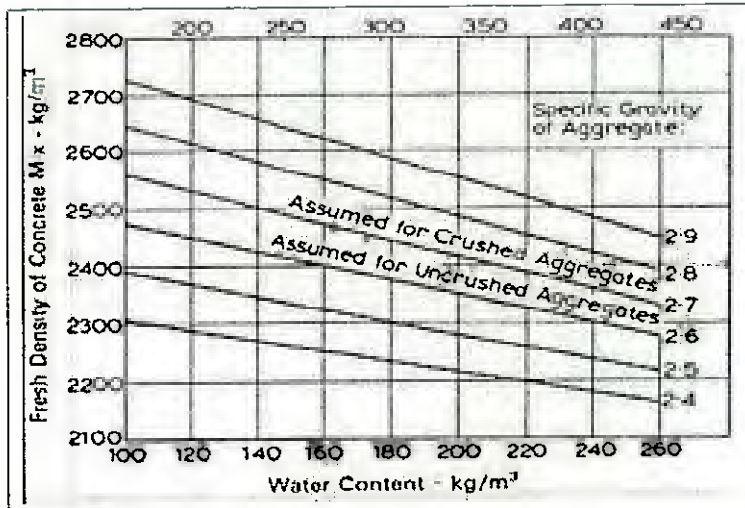


Table 20.47. App. Free water content required for various workability according to 1988 British Method

Aggregate		*Water content kg/m³ for slump*			
Max. size mm	*Type*	0 — 10 mm	10 — 30 mm	30 — 60 mm	60 — 180 mm
		Vee Bee secons > 12	6 — 12	3 — 6	0 — 3
10	Un crushed	150	180	205	225
	crushed	180	205	230	250
20	Un crushed	135	160	180	195
	crushed	170	190	210	225
30	Un crushed	115	140	160	175
	crushed	155	175	190	205

Table 20.48. Reduction in water content of table 21.47 when fly ash used.

% of fly ash in cementitious material	*Slump in mm Vee Bee seconds*	*Reduction in water content kg/m³*			
		0 — 10 > 12	10 — 30 6 — 12	30 — 60 3 — 6	60 — 180 0 — 3
10		5	5	5	10
20		10	10	10	15
30		15	15	20	20
40		20	20	25	25
50		25	25	30	30



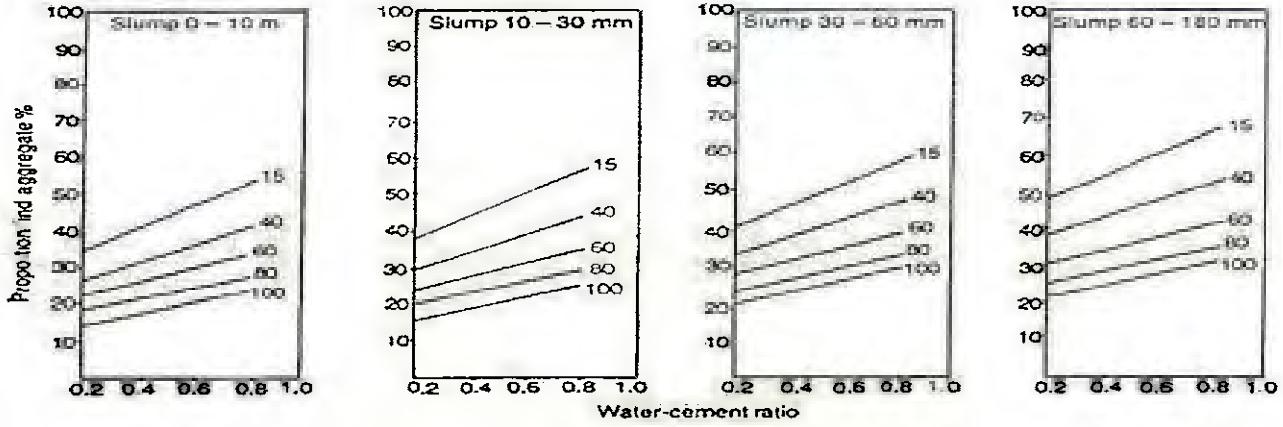


Fig 20.12. (b)

Table 20.46 App Compressive strength of concrete in Mpa with w/c of 0.5 as per DOE for OPC (Type I), SRC (Type v) and RHC at diff time period

Type of cement		3 days	7 days	28 days	91 days
OPC	Uncrushed	18-22	27-30	40-42	48-49
SRC	Crushed	23-27	33-36	47-49	55-56
RHC	Uncrushed	25-29	34-37	46-48	53-54
RHC	Crushed	30-34	40-43	53-55	60-61

Table 1,2 and 3 for ACI Method Concrete Mix Design

(1) Dry Bulk Volume of coarse aggregate/ unit volume of concrete as per ACI 211.1-91

Maximum size of aggregate	Bulk volume of dry rodded CA /unit volume of concrete for fineness modulus of sand of			
FM	2.4	2.6	2.8	3.00
10	0.5	0.48	0.46	0.44
12.5,	0.59	0.57	0.55	0.53
20 (25,40,50,70)	0.66	0.64	0.62	0.60
150	.87	0.85	0.83	0.81

(2) Relation between water/cement ratio & average compressive strength of concrete, as per ACI211.1-91

Average compressive strength at 28 days	Effective water/cement ratio (by mass)	
MPa	Non air entrained concrete	Air entrained concrete
45	0.38	-
40	0.43	-
35 (30,25,20)	0.48	0.4
15	0.8	0.71

(3) Requirements of ACI-318-89 for w/c ratio & strength for special exposure conditions

Exposure condition	Maximum w/c ratio, normal density aggregate concrete	Minimum design strength, low density aggregate concrete MPa
Concrete intended to be watertight		
(a) Exposed to fresh water	0.5	25
(b) Exposed to sea water	0.45	30
Concrete exposed to freezing in a moist condition	0.45	30
For corrosion protection of reinforced concrete exposed to de icing salts, sea water	0.4	33

Table 4,5 and 6 for ACI Method Concrete Mix Design

(4) Recommended value of slump for various types of construction as per ACI 211.1-91

Type of construction	Range of slump (mm)
Reinforces foundation walls & footings	20-80
Plain footings,substructure wall	20-80
Beams & reinforced walls	20-100
Building columns	20-100
Pavements & slabs	20-80
Mass concrete	20-80

(5) Approximate requirements for mixing water & air content for different workabilities & nominal maximum size of aggregates as per ACI211.1-91

Non air entrained concrete				
Workability or air content (Slump)	Water content, kg/m3 of concrete for indicated maximum aggregate size			
	10 mm (25, 40,50,70)	12.5 mm	20 mm	150 mm
30 -50 mm	205	200	185	125
80-100 mm	225	215	200	140
150-180 mm	240	230	210	
Approx entrapped air (%)	3	2.5	2	0.2

(6) First estimate of density of fresh concrete as pe ACI 211.1-91

Maximum size of aggregate (mm)	First estimate of density of fresh concrete	
	Non air entrained kg/m3	Air entrained kg/m3
10	2285	2190
12.5 (20,25,40,50)	2315	2235
20	2355	2280
150	2505	2435

As per ACI in absence of record; required increase in mean strength for specified design strength

Specified design Strength (Mpa)	Less than 21	21-35	35 or more
Required Increase in mean strength (Mpa)	7	8.5	10

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

REEND-Sem Examinations, January/February 2026

Class: SY BTECH (CIVIL)[Working Professional]. Semester: III

Program: Civil

Name of the Course: Basics of Surveying Course Code : PC-BTC303

28|01|2026

Instructions:

1. **Solve any 5 questions**
2. Assume suitable data if necessary and state the clearly.

Que. No		Points	CO	BL	Module no
1	A. Write a note on followings- 1. Applications of surveying 2. Degree of accuracy in chaining B. 1. What is local attraction? how it is deducted and adjusted? Methods of application of corrections. 2. State the difference between prismatic compass and surveyor compass.	10 10	1,2 2,3	2 2	I 2
2	Compute the Gales Traverse table using following data. Line / Length / Angle AB / 100 / $95^0 0'$ BC / 150 / $110^0 30'$ CD / 200 / $97^0 45'$ DA / 180 / $56^0 45'$ WCB of line AB is $45^0 00'$. Independent coordinate of point A, Latitude= 1000 and departure= 1000 Use Bowditch rule for corrections.	20	1,2	2	3
3	A.The following bearings were observed in traversing, with a compass, an area here local attraction as suspected. Find the amounts of local attraction at different stations, the correct	10	1,2	3	2

bearings of lines and the included angles. Also draw a sketch of the plot if AB = 180 m, BC = 120 m and CD = 60 m and show in it all the included angles.

Line	Fore Bearing	Back Bearing
AB	$59^0 00'$	$239^0 00'$
BC	$139^0 30'$	$317^0 00'$
CD	$215^0 15'$	$36^0 30'$
DE	$208^0 00'$	$29^0 00'$
EA	$318^0 30'$	$138^0 45'$

B.
Explain profile levelling and cross-section levelling. 10 3 2 2

4 A. What is the principle of plane table survey? 05 1 2 4

B. Name the different instruments and accessories used in plane table survey. 05 3 2 4

C. What are the advantages and disadvantages of plane tabling? 05 2 2 4

D. Describe with a sketch how plane table traversing is done. 05 4 2 4

5 A. 05 2 2 2

A level is set up at a point 150 m rom A and 100 m rom B , the observed staff readings at A and B are 2.525 and 1.755 respectively. Find the true difference o level between A and B.

B. 10 3 3 2

St	BS	IS	FS	RISE	FALL	RL	Remark
1	3.650					108.260	
2		??		2.750			
3		2.830					
4		3.640					

	5	??		2.420				CP		
	6		2.410			1.320				
	7		2.320							
	8		3.000							
	9	-2.710*								
	10	??	??			2.750		CP		
	11		??			1.320				

*Negative reading indicates staff held against ceiling

C.

Describe the process of measuring the horizontal angle.

05 | 3 | 2 | 4

6. A.

The following off sets were taken at 15 m intervals from a survey line to an irregular boundary line:

3.50, 4.30, 6.75, 5.25, 7.50, 8.80, 7.90, 6.40, 4.40, 3.25 m

calculate the area enclosed between the survey line, the irregular boundary line, and the first and last off sets, by

(a) The trapezoidal rule

(b) Simpson's rule

10 | 2 | 3 | 3

B.

How would you measure deflection angles?

10 | 4 | 2 | 3

7 A. A tacheometer as set up at a station and the following readings were obtained on a staff vertically held.

10 | 3 | 4 | 5

Calculate the horizontal distance D and RL o D, hen the constants of instrument are 100 and 0.15.

In.St.	Staff St	Vr. Angle	Staff Readings	Remark
C	BM	$-5^0 20'$	1.500, 1.800,2.450	RL of BM= 750.50m
C	D	$+8^0 12'$	0.750,1.500, 2.250	

B.

Derive the expressions for horizontal and vertical distances in the fixed-hair method when the staff is held normal to the line of sight and the measured angle is that of elevation.

10 | 4 | 3 | 5