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SJC INSTITUTE OF TECHNOLOGY

(An Autonomous Institute under VTU, Belagavi)

FIRST SEMESTER M.Tech DEGREE SEMESTER END EXAMINATIONS

MARCH 2026

Course:	NUMERICAL METHODS AND OPTIMIZATION TECHNIQUES		
Course Code:	MCV101	Program:	M.Tech in Structural Engineering
Max Marks:	100	Duration:	03 Hours

Note:

1. Answer ONE question from each MODULE and Question 1 & 2 is compulsory.
2. Any missing Data can be suitably assumed.

Q. No.	MODULE - 1				Marks	CO	RBTL																								
Q1	a	<p>A firm produces three products. These products are processed on three different machines. The time required to manufacture one unit of each of the three products and the daily capacity of the three machines are given in the table below:</p> <table border="1"> <thead> <tr> <th rowspan="2">Machine</th> <th colspan="3">Time per unit(minutes)</th> <th rowspan="2">Machine capacity (minutes/day)</th> </tr> <tr> <th>Product 1</th> <th>Product 2</th> <th>Product 3</th> </tr> </thead> <tbody> <tr> <td>M1</td> <td>2</td> <td>3</td> <td>2</td> <td>440</td> </tr> <tr> <td>M2</td> <td>4</td> <td>-</td> <td>3</td> <td>470</td> </tr> <tr> <td>M3</td> <td>2</td> <td>5</td> <td>-</td> <td>430</td> </tr> </tbody> </table> <p>It is required to determine the daily number of units to be manufactured for each product. The profit per unit for product 1, 2 and 3 is Rs. 4, Rs.3 and Rs.6 respectively. It is assumed that all the amounts produced are consumed in the market. Formulate the mathematical linear programming problem that will maximize the daily profit. Examine using simplex method.</p>				Machine	Time per unit(minutes)			Machine capacity (minutes/day)	Product 1	Product 2	Product 3	M1	2	3	2	440	M2	4	-	3	470	M3	2	5	-	430	20	1	L4
Machine	Time per unit(minutes)			Machine capacity (minutes/day)																											
	Product 1	Product 2	Product 3																												
M1	2	3	2	440																											
M2	4	-	3	470																											
M3	2	5	-	430																											
MODULE - 2																															
Q2	a	<p>An open cylindrical vessel is to be constructed to transport 100m³ of chemical from store to factory. The sheet metal used for bottom costs Rupees 1000/m² and that used for cylindrical walls cost Rupees 500/m². If it cost Rupees 100 for each round trip of vessel. Analyze the problem and find the dimensions of vessel for minimum cost. Assume that vessel has no salvage value.</p>				20	2	L4																							
MODULE - 3																															
Q3	a	<p>Apply and fit a nonlinear relationship between the following data:</p> <table border="1"> <thead> <tr> <th>x</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> </tr> </thead> <tbody> <tr> <th>y</th> <td>1.7</td> <td>1.8</td> <td>2.3</td> <td>3.2</td> </tr> </tbody> </table>				x	1	2	3	4	y	1.7	1.8	2.3	3.2	10	3	L3													
x	1	2	3	4																											
y	1.7	1.8	2.3	3.2																											

	b	Fit a binomial distribution for the following data and develop the theoretical frequencies and actual ones: <table border="1" style="margin-left: 20px;"> <tr> <td>x</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td>y</td> <td>2</td> <td>14</td> <td>20</td> <td>34</td> <td>22</td> <td>8</td> </tr> </table>	x	0	1	2	3	4	5	y	2	14	20	34	22	8	10	3	L3										
x	0	1	2	3	4	5																							
y	2	14	20	34	22	8																							
OR																													
	a	Develop the line of best fit for the following data of heights and weights of students of a school using the Least Squares method: <ul style="list-style-type: none"> Height (in centimeters): [160, 162, 164, 166, 168] Weight (in kilograms): [52, 55, 57, 60, 61]. 	10	3	L3																								
Q4	b	In an investigation into the health and nutrition of two groups of children of different social status the following results are obtained. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Social status</th> <th>Poor</th> <th>Rich</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>Health</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Below Normal</td> <td>130</td> <td>20</td> <td>150</td> </tr> <tr> <td>Normal</td> <td>102</td> <td>108</td> <td>210</td> </tr> <tr> <td>Above Normal</td> <td>24</td> <td>96</td> <td>120</td> </tr> <tr> <td>Total</td> <td>256</td> <td>224</td> <td>480</td> </tr> </tbody> </table> <p>Build the relation between the health and their social status.</p>	Social status	Poor	Rich	Total	Health				Below Normal	130	20	150	Normal	102	108	210	Above Normal	24	96	120	Total	256	224	480	10	3	L3
Social status	Poor	Rich	Total																										
Health																													
Below Normal	130	20	150																										
Normal	102	108	210																										
Above Normal	24	96	120																										
Total	256	224	480																										
MODULE - 4																													
	a	Using Taylor's series method obtain the solution of $dy/dx = 3x + y^2$ and $y = 1$, when $x = 0$. Solve for the value of y for $x = 0.1$, correct to four places of decimals.	10	3	L3																								
Q5	b	Using Euler's method solve for an approximate value of y corresponding to $x = 2$, given that $dy/dx = x + 2y$ and $y = 1$ when $x = 1$.	10	3	L3																								
OR																													
	a	Apply Runge -Kutta method (fourth order) to find an approximate value of y when $x = 0.2$, given that $dy/dx = x + y^2$, $y = 1$ when $x = 0$.	10	3	L3																								
Q6	b	The following offsets 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. Solve for the area enclosed between the survey line, the irregular boundary line and the first and last offsets by applying Trapezoidal and Simpson's Rules.	10	3	L3																								

MODULE – 5

Q7	a	List objectives of Project management.	5	4	L1																																										
	b	<p>The following table shows the jobs of a network along with their time estimates.</p> <table border="1" style="margin-left: 40px;"> <thead> <tr> <th rowspan="2">Activity</th> <th colspan="3">Estimated duration (weeks)</th> </tr> <tr> <th>Optimistic (t_o)</th> <th>Most likely (t₃)</th> <th>Pessimistic (t_p)</th> </tr> </thead> <tbody> <tr><td>1-2</td><td>1</td><td>7</td><td>13</td></tr> <tr><td>1-6</td><td>2</td><td>5</td><td>14</td></tr> <tr><td>2-3</td><td>2</td><td>14</td><td>26</td></tr> <tr><td>2-4</td><td>2</td><td>5</td><td>8</td></tr> <tr><td>3-5</td><td>7</td><td>10</td><td>19</td></tr> <tr><td>4-5</td><td>5</td><td>5</td><td>17</td></tr> <tr><td>6-7</td><td>5</td><td>8</td><td>29</td></tr> <tr><td>5-8</td><td>3</td><td>3</td><td>9</td></tr> <tr><td>7-8</td><td>8</td><td>17</td><td>32</td></tr> </tbody> </table> <p>Evaluate:</p> <p>i) the expected duration and variance of each activity. ii) earliest and latest occurrence for each event. iii) expected project length. iv) the variance and standard deviation of project length v) the probability of the project completing in 40 days.</p>	Activity	Estimated duration (weeks)			Optimistic (t _o)	Most likely (t ₃)	Pessimistic (t _p)	1-2	1	7	13	1-6	2	5	14	2-3	2	14	26	2-4	2	5	8	3-5	7	10	19	4-5	5	5	17	6-7	5	8	29	5-8	3	3	9	7-8	8	17	32	15	4
Activity	Estimated duration (weeks)																																														
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7-8	8	17	32																																												
OR																																															
Q8	a	Define resource levelling? What is its purpose?	5	4	L1																																										
	b	<p>A project has the following times schedule:</p> <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Activity</th> <th>Times in weeks</th> <th>Activity</th> <th>Times in weeks</th> </tr> </thead> <tbody> <tr><td>(1 – 2)</td><td>4</td><td>(5 – 7)</td><td>8</td></tr> <tr><td>(1 – 3)</td><td>1</td><td>(6 – 8)</td><td>1</td></tr> <tr><td>(2 – 4)</td><td>1</td><td>(7 – 8)</td><td>2</td></tr> <tr><td>(3 – 4)</td><td>1</td><td>(8 – 9)</td><td>1</td></tr> <tr><td>(3 – 5)</td><td>6</td><td>(8 – 10)</td><td>8</td></tr> <tr><td>(4 – 9)</td><td>5</td><td>(9 – 10)</td><td>7</td></tr> <tr><td>(5 – 6)</td><td>4</td><td></td><td></td></tr> </tbody> </table> <p>Construct the network and Assess:</p> <p>i) TE and TL for each event. ii) Float for each activity. iii) Critical path.</p>	Activity	Times in weeks	Activity	Times in weeks	(1 – 2)	4	(5 – 7)	8	(1 – 3)	1	(6 – 8)	1	(2 – 4)	1	(7 – 8)	2	(3 – 4)	1	(8 – 9)	1	(3 – 5)	6	(8 – 10)	8	(4 – 9)	5	(9 – 10)	7	(5 – 6)	4			15	4	L5										
Activity	Times in weeks	Activity	Times in weeks																																												
(1 – 2)	4	(5 – 7)	8																																												
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(2 – 4)	1	(7 – 8)	2																																												
(3 – 4)	1	(8 – 9)	1																																												
(3 – 5)	6	(8 – 10)	8																																												
(4 – 9)	5	(9 – 10)	7																																												
(5 – 6)	4																																														

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SJC INSTITUTE OF TECHNOLOGY

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FIRST SEMESTER M.Tech DEGREE SEMESTER END EXAMINATIONS

MARCH 2026

Course:	ARTIFICIAL INTELLIGENCE AND APPLICATIONS IN CIVIL ENGINEERING			
Course Code:	MCV102	Program:	M.Tech in Structural Engineering	
Max Marks:	100	Duration:	03 Hours	

Note:

1. Answer ONE question from each MODULE and Question 1 & 2 is compulsory.
2. Any missing Data can be suitably assumed.

Q. No.	MODULE - 1			Marks	CO	RBTL
Q1	a	Define Swarm intelligence and Cognitive Computing.	4	1	L1	
	b	Compare Traditional AI and Modern AI approaches.	6	1	L2	
	c	Classify the different types of Artificial Intelligence using suitable criteria. Explain any 2 in detail.	10	1	L2	
MODULE - 2						
Q2	a	Define Machine Learning and Concept Learning.	4	2	L1	
	b	Describe the Machine Learning process model and explain each step involved in building a learning system	6	2	L2	
	c	Apply Reinforcement Learning concepts to explain its elements with a neat sketch.	10	2	L3	
MODULE - 3						
Q3	a	Define Feed forward and Recurrent neural networks.	4	3	L1	
	b	Explain the biological motivation behind the development Artificial Neural Networks.	6	3	L2	
	c	Analyze how deep learning models assist in automated crack detection in bridges and pavements	10	3	L4	
OR						
Q4	a	Define Artificial Neural Networks and back propagation?	4	3	L1	
	b	Explain the structure and working principle of a perceptron?	6	3	L2	
	c	Analyze the representational limitations of a single-layer perceptron with a suitable example.	10	3	L4	
MODULE - 4						
Q5	a	What are the main components of the Fuzzy Interference System?	4	4	L1	

	b	Explain how Fuzzy logic differs from classical logic.	8	4	L2
	c	Analyze the application of fuzzy logic in civil engineering problems such as concrete mix design, traffic control, and construction risk assessment.	8	4	L4
OR					
Q6	a	Define Fuzzification and Defuzzification	4	4	L1
	b	Define Linguistic Variables and Fuzzy Sets. Explain their role in fuzzy systems with examples	8	4	L2
	c	Analyze the advantages of fuzzy logic in handling imprecision and uncertainty in civil engineering decision making	8	4	L4
MODULE - 5					
Q7	a	State the importance of Computer vision in engineering applications.	4	5	L1
	b	Explain the working principle of a digital camera.	8	5	L2
	c	Evaluate the role of geometric primitives used in Computer Vision for representing and interpreting images.	8	5	L5
OR					
Q8	a	What are primitives of image processing?	4	5	L1
	b	Explain sampling and aliasing and their effects on digital images	8	5	L2
	c	Evaluate the role of 3D transformations in interpreting and understanding real-world scenes in Computer Vision applications.	8	5	L5

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FIRST SEMESTER M.Tech DEGREE SEMESTER END EXAMINATIONS

MARCH 2026

Course:	ADVANCED DESIGN OF RCC STRUCTURES		
Course Code:	MCV103	Program:	M.Tech in Structural Engineering
Max Marks:	100	Duration:	03 Hours

Note:

1. Answer ONE question from each MODULE and Question 1 & 2 is compulsory.
2. Any missing Data can be suitably assumed.

Q. No.		MODULE - 1	Marks	CO	RBTL
Q1	a	Explain the concept and need of moment redistribution in continuous beams.	6	1	L2
	b	Design a rectangular slab 7.5m x 5m simply supported on all edges. The LL= 4KN/m ² , and floor finish load=1kN/m ² . The slab is orthotopically reinforced with $\mu=0.75$. Use M20 concrete and Fe 415 HYSD bars. Sketch the reinforcement details.	14	1	L4
MODULE - 2					
Q2	a	Explain any two different types of flat slab with neat sketches.	6	2	L2
	b	A RC grid floor is to be designed to cover a floor area of 12m x 18m. The spacing of the ribs in mutually perpendicular directions is 1.5m c/c. LL on floor is 3kN/m ² . Adopt M20 concrete & Fe 415 steel. Assume ends of slabs are simply supported. Analyze the grid floor by IS 456: 2000 method design suitable reinforcements in the grid floor.	14	2	L4
MODULE - 3					
Q3	a	Design Shell & foundation of the RC chimney for the following data: Height of chimney is 80m. Exterior diameter at top is 4m Exterior diameter at bottom is 5m Shell thickness at top is 200mm Shell thickness at bottom is 400mm Wind intensity is 1.5 kN/m ² Thickness of firebrick lining is 100mm Air gap is 100mm Temperature difference between inside and outside chimney shaft is 75 degrees. Coefficient of thermal expansion of steel $E_s: 210 \times 10^3 \text{N/mm}^2$ Unit weight of brick lined: 20kN/m ³ Use M25 grade concrete and Fe 415 HYSD bars. Sketch the reinforcement details in longitudinal section and plan. Assume the	20	3	L4

		stresses in concrete and steel are within safe limits @ base of the chimney shell.			
OR					
Q4	a	Design a typical interior span of a continuous deep beam using the following data: Span of beam = 9m, Overall depth = 4.5m, Width of supports = 0.9m, Width of beam = 0.4m, UDL $w = 200\text{kN/m}$. Use M20 concrete and Fe 415 HYSD bars.	20	3	L4
MODULE - 4					
Q5	a	Differentiate between bunkers and Silos	6	4	L2
	b	Design a circular bunker to store 300kN coal. Unit weight of coal is 8KN /m^3 . Angle of repose is 25 degrees. sketch the details of the circular bunker. Use M20 grade concrete and Fe-415 steel.	14	4	L4
OR					
Q6	a	A cylindrical silo has an internal diameter of 6m and 20m deep (cylindrical portion) with a conical hopper bottom. The material stored is wheat with density of 8kN/m^3 . The coefficient of friction between wall and material is 0.444. The ratio of horizontal to vertical pressure is 0.40. Angle of repose is 25° . Design the reinforcement in the silo walls. Adopt M20 grade concrete and Fe 415 HYSD bars, Adopt Janssen's theory for pressure calculations.	20	4	L4
MODULE - 5					
Q7	a	Define: (i) Form work (ii) Shuttering	4	5	L1
	b	Explain any four materials used for formwork with their advantages	8	5	L2
	c	Analyze the advantages and limitations of aluminum formwork compared to conventional timber formwork.	8	5	L4
OR					
Q8	a	List the requirements of good formwork.	4	5	L1
	b	Explain the different types of loads acting on formwork.	8	5	L2
	c	Analyze potential failure modes in modern formwork systems and suggest preventive measures.	8	5	L4

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FIRST SEMESTER M.Tech DEGREE SEMESTER END EXAMINATIONS

MARCH 2026

Course:	SPECIAL CONCRETE		
Course Code:	MCV114E	Program:	M.Tech in Structural Engineering
Max Marks:	100	Duration:	03 Hours

Note:

1. Answer ONE question from each MODULE and Question 1 & 2 is compulsory.
2. Any missing Data can be suitably assumed.

Q. No.		MODULE - 1	Marks	CO	RBTL
Q1	a	What is Rheology of Concrete?	4	1	L1
	b	Explain the factors which governs the selection of mix proportion of concrete.	6	1	L2
		<p>Design a concrete mix for grade M40. Grade designation : M40 Type of cement: OPC 43 grade conforming to IS 8112 Maximum nominal size of aggregates: 20 mm Minimum cement content: 320 kg/m³ Maximum water cement ratio: 0.45 Workability: 100 mm (slump) Exposure condition: Severe (for reinforced concrete) Method of concrete placing: Pumping Degree of supervision: Good Type of aggregate: Crushed angular aggregate Maximum cement content: 450 kg/m³ Chemical admixture type : : Super plasticizer</p> <p>TEST DATA FOR MATERIALS</p> a) Cement used : OPC 43 grade conforming to IS 8112 Specific gravity of cement: 3.10 c) Chemical admixture: Super plasticizer conforming to IS 9103 d) Specific gravity of Coarse aggregate: 2.70, Fine aggregate: 2.70 e) Water absorption: Coarse aggregate 0.5 percent, Fine aggregate: 1.0 percent f) Free (surface) moisture Coarse aggregate: Nil (absorbed moisture also nil), Fine aggregate: Nil g) Sieve analysis Coarse aggregate: Conforming to Table 2 of IS: 383 : Fine aggregate: Conforming to Zone I of IS: 383	10	1	L4
MODULE - 2					
Q2	a	Write a note on "NO FINES CONCRETE".	4	2	L1
	b	Briefly explain the basic principles and requirements of SCC.	8	2	L2

	c	Explain the different types of aggregates used in HDC. Mention its applications.	6	2	L3
MODULE - 3					
Q3	a	What is Ferro cement? What are the different materials used in Ferro cement?	4	3	L1
	b	Explain the factors affecting properties of fibre reinforced concrete.	8	3	L2
	c	A rural community requires a lightweight, crack-resistant water storage tank. Justify the suitability of ferro-cement for this application by applying its properties.	8	3	L3
OR					
Q4	a	Write a note on natural fibres and its benefits in concrete.	4	3	L1
	b	Explain the properties and limitation of Fiber Reinforced Concrete.	8	3	L2
	c	Apply the crack arrest and toughening mechanisms of Fibre Reinforced Concrete to explain how fibres improve its performance.	8	3	L3
MODULE - 4					
Q5	a	Write a short note on: Mass concrete	4	4	L1
	b	Apply curing and compaction principles to explain strength variation in roller compacted concrete.	8	4	L3
	c	Analyze the suitability of nondestructive testing for assessing fire-damaged concrete structures.	8	4	L4
OR					
Q6	a	Write a short note on: High strength concrete.	4	4	L1
	b	Illustrate the mix design procedure for mass concrete as per IS: 10262 - 2019.	8	4	L3
	c	Explain the principle of the Rebound Hammer Test and apply it to assess the surface hardness and quality of concrete in an existing structure.	8	4	L4
MODULE - 5					
Q7	a	What is Polymerization? Write the properties of polymer concrete	4	5	L1
	b	Explain the advantages and disadvantages of Bacterial concrete.	8	5	L2
	c	Assess the conditions for the requirements of Ultra high performance concrete.	8	5	L5
OR					
Q8	a	Write a short note on Polymer concrete	4	5	L1
	b	Explain briefly recycled aggregate concrete with their suitability for structural applications.	8	5	L2
	c	How carbonation and corrosion is assessed in steel?	8	5	L5

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FIRST SEMESTER M.Tech DEGREE SEMESTER END EXAMINATIONS

MARCH 2026

Course:	ROAD SAFETY ENGINEERING AND MANAGEMENT			
Course Code:	MCV115E	Program:	M.Tech in Structural Engineering	
Max Marks:	100	Duration:	03 Hours	

Note:

1. Answer ONE question from each MODULE and Question 1 & 2 is compulsory.
2. Any missing Data can be suitably assumed.

Q. No.	MODULE - 1		Marks	CO	RBTL
Q1	a	Name any six common types of crashes on Indian highways.	6	1	L1
	b	Explain how driver fatigue influences accident risk.	7	1	L2
	c	Apply the concept of perception–reaction time to analyze a situation where a driver suddenly encounters an obstacle on the road.	7	1	L3
MODULE - 2					
Q2	a	State any three assumptions of linear regression and ANOVA.	6	2	L1
	b	Explain how regression to the mean affects before–after crash studies.	7	2	L2
	c	Apply time series analysis to forecast traffic flow or accident trends.	7	2	L3
MODULE - 3					
Q3	a	State the typical stages of crash investigation.	6	3	L1
	b	Explain the techniques used to improve traffic safety of a midblock hazardous section?	7	3	L2
	c	Apply the Road Safety Investigation Framework to analyze a hypothetical crash scenario.	7	3	L3
OR					
Q4	a	List the key elements of a road safety audit process.	6	3	L1
	b	Explain the difference between a Road Safety Audit and a Road Safety Inspection.	7	3	L2
	c	Apply Road Safety Audit principles to identify pedestrian safety issues on a highway section.	7	3	L3
MODULE - 4					
Q5	a	State Newton’s laws used in crash reconstruction.	6	4	L1
	b	Apply the yaw mark formula to determine whether a vehicle exceeded a safe curve speed.	7	4	L3
	c	Distinguish between friction-based deceleration marks made before impact and post-impact marks caused by vehicle deformation.	7	4	L4

OR					
Q6	a	Define drag factor, skid mark, and critical speed yaw.	6	4	L1
	b	Apply crash reconstruction steps to analyse a multi-vehicle collision at an intersection.	7	4	L3
	c	Analyze a combination of take-off angle, trajectory, and landing distance to determine crash severity.	7	4	L4
Module – 5					
Q7	a	Explain geometric design in road engineering? Name one design element that enhances safety.	6	5	L2
	b	Apply guidelines to propose safe detour routes for road maintenance activities.	7	5	L3
	c	Analyze the relationship between highway geometry (curvature, gradient, lane width) and crash patterns.	7	5	L4
OR					
Q8	a	List & Explain the key objectives of accident prevention through planning.	6	5	L2
	b	Apply traffic management measures to reduce rear-end collisions on a busy urban arterial.	7	5	L3
	c	Analyze traffic flow characteristics to identify potential accident hotspots.	7	5	L4

