PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem 2019-20

Course Code: CIV 101

Course Name: ELEMENTS OF CIVIL ENGINEERING

Program & Sem: B.Tech (Physics Cycle) & I

Date: 30.09.2019

Time: 1.00 PM to 2.00 PM

Max Marks: 30

Weightage: 15%

Instructions:

(i) Read the question properly and answer accordingly.
(ii) The question paper consists of 3 parts.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries four marks. (3Qx4M=12M)

1. Draw the phase diagram for partially saturated soil and dry soil.

(C.O.NO.1) [Knowledge]

2. Draw the neat sketch of pile foundation with brief note. (C.O.NO.1) [Knowledge]

3. List the importance of bridges.

(C.O.NO.1) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries five marks. (2Qx5M=10M)

4. A single slab was provided for the foundation to avoid the differential settlement, which carries number of columns and wall. Identify the foundation and explain that foundation with neat sketch.

(C.O.NO.1) [Knowledge]

5. Explain the cable stayed bridge with the diagram.

(C.O.NO.1) [Knowledge]

Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries four marks.   (2Qx4M=8M)

6. A single storied railway station is planned to construct using stone masonry on dry granular soil deposit. While moving from this station to next station the train has to cross the deep valley of width 1800 meters.

Answer the following question based on paragraph-

    a)   Which type of structure would you propose for railway station?
    b)   Which type of bridge will be feasible for interconnecting the two stations?
    c)   How many number of phases required to represent the dry soil deposit?
    d)   Which type of foundation will be suitable for the railway station?

(C.O.NO.1) [Application]

7. Differentiate between the load bearing structure and framed structure (any four differences).

(C.O.NO.1) [Comprehension]

SCHOOL OF ENGINEERING

Semester: 1st Semester

Course Code: CIV101

Course Name:

Date: 30 Sept. 2019

Time: 1 hour

Max Marks: 30

Weightage: 15%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Application type [Marks allotted]	Total Marks
			K	K	K	
1	1	1	4			4
2	1	1	4			4
3	1	1	4			4
4	1	1		5		5
5	1	1		5		5
6	1	1			4	4
7					4	4
	Total Marks		12	10	8	30

K =Knowledge Level   C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

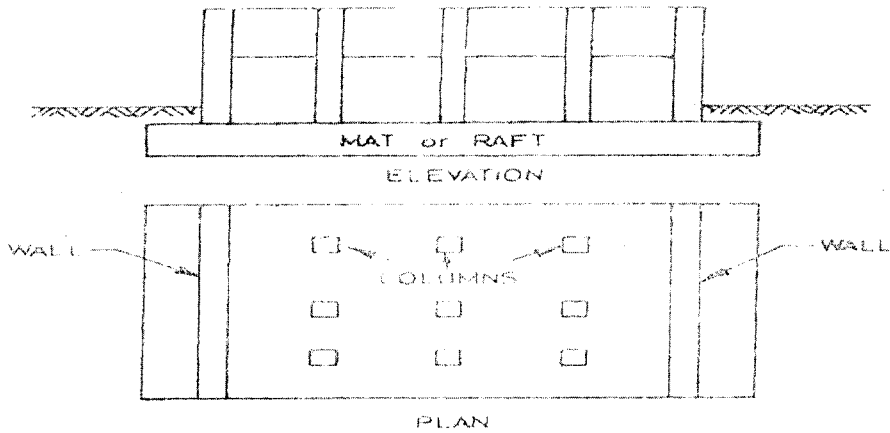[I hereby certify that All the questions are set as per the above guide lines. Mr. Jagdish Biradar]

Reviewers' Comments

SCHOOL OF ENGINEERING

SOLUTION

Date: 30 Sept. 2019

Semester: 1st Semester

Time: 1 hour

Course Code: CIV101

Max Marks: 30

Course Name:

Weightage: 15%

Part A   (3Q x 4M = 12 Marks)
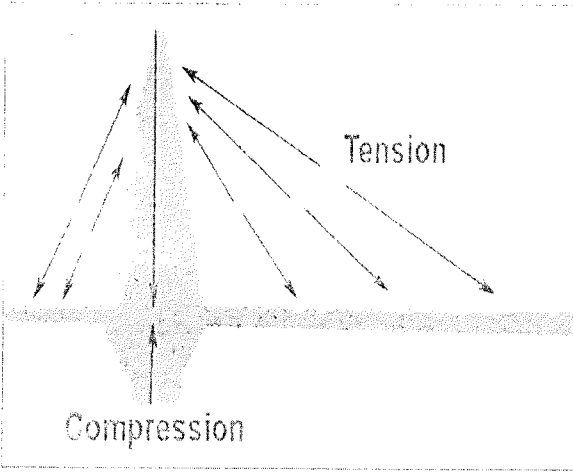
Q No	Solution	Scheme of Marking	Max. Time required for each Question
1		2 marks for each phase diagram	5 mins
2	1. A pile is a slender column made of wood, concrete or steel. 2. A pile is either driven into the soil or formed in situ by excavating a hole and then filling it with concrete. 3. A group of piles are driven to the required depth and are capped with R.C.C. Slab, over which super structure is built. 4. The pile transfer the load to soil by friction or by direct bearing; in the direct bearing case, piles being taken up to hard strata. 5. This type of foundations is used when top soil is not capable of taking the load of the structure even at 3-4 m depth.	2 mark for diagram, 2 mark for explanation	7 mins
3	**Importance of Bridges:** • **Connects difficult terrains** • **Easy trade and transportation of goods**	1 mark for each point	5 mins

	• Reduces travelling time • Military use • Political and economic importance • Less emission due to displacement		

Part B   (2Q x 5M = 10 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
4	Mat or raft Foundation 1. A mat or raft foundation is a large slab supporting a number of columns and walls under the entire structure or a large part of the structure. 2. A mat is required when the allowable soil pressure is low or where the columns and walls are so close that individual footings would overlap or nearly touch each other. 3. Mat foundations are useful in reducing the differential settlements on non-homogeneous soils or where there is a large variation in the loads on individual columns. Mat Foundation	1 mark for identification. 2 mark for explanation, 2 mark for diagram	10 mins

5.		3 mark for explanation. 2 mark for diagram	10 mins
	Cable-Stayed Definition - Similar to suspension bridges except they only need one tower. The cables are attached directly from the tower to the roadway. Pros - much less expensive than suspension bridges. Cons - can be dangerous in high winds, cables require special treatment so they don't corrode and break Uses - Becoming the most popular bridges for medium-length spans of 500 - 3,000 feet (distances longer than cantilever bridges and shorter than suspension bridges). Tension Compression		

Part C   (2Q x 4M = 8 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	i. Load bearing structure ii. Suspension bridge iii. 02 iv. Continuous foundation	Each part for 1 mark	10 min
7		Each 1 marks	5 mins

FRAMED STRUCTURES	LOAD BEARING STRUTURES
Load transfer path is from slab/floor to beam, beam to column and column to footing.	Load transfer path is from slab/floor to wall, wall to footing.
Multi storey buildings can be constructed.	Limited storey buildings can only be constructed.
Framed structure is more resistant to Earthquake.	Load bearing structure is less resistant to Earthquake.
Carpet area available is more.	Carpet area available is less.

Mostly used a form of construction.	Rarely used a form of construction now a days.
Excavation for this type of construction is less.	Excavation for this type of construction is more.
The speed of construction is more.	The speed of construction is less.
Cost of repair of the framed structure is more.	Cost of repair of load bearing structure is less.
There is not much increase in cost with an increase in depth of foundation.	Foundation cost of Load Bearing is more than Framed Structure if the depth of foundation increases beyond 1.5m.
No limitation for wall/room.	Limitation of wall over wall/ room over room.
The frame can be RCC, Steel, Wood frame etc.	Load Bearing walls can be of Brick, Stone, concrete block etc.
Large openings in walls are possible.	Limitations for openings in walls.
In framed structural system external & internal walls serve only the purpose of enclosures for the creation of rooms and protection from the weather.	In load bearing structural system external & internal walls serve as a structural element as well as the purpose of the enclosure for protection from weather i.e. rain, sound, heat, fire etc.

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem 2019-20

Course Code: CIV 101

Course Name: ELEMENTS OF CIVIL ENGINEERING

Program & Sem: B. Tech (Physics cycle) & I

Date: 18.11.2019

Time: 1.00 PM to 2.00 PM

Max Marks: 30

Weightage: 15%

Instructions:
(i) Read the question properly and answer accordingly.
(ii) The question paper consists of 3 parts.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries three marks. (4Qx3M=12M)

1. Write a note about GPS. **[3m] (C.O.1) [Knowledge]**

2. Match the following according to their treatment.

1. Screening	a. Hardness
2. Softening	b. Suspended matter
3. Sedimentation	c. Floating matter

[3m] (C.O.1) [Knowledge]

3. Two forces 100 N and 150 N are acting simultaneously at a point with the angle

between them is 45. Find the magnitude of the resultant force.

[3m] (C.O.2) [Knowledge]

4. Explain any three types of precipitation. **[3m] (C.O.1) [Knowledge]**

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries five marks.   (2Qx5M=10M)

5. Write a note on (i) Purposes of construction of Dam (ii) Classification of irrigation.

[5M] (C.O.NO1) [Knowledge]

6. Find the P and α from the coplanar concurrent force system as shown in Figure 01.

The resultant is 500 N and acting along the positive X-axis.
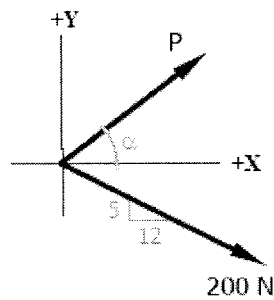
[5M] (C.O.NO2) [Knowledge]

Figure 01.

Part C [Problem Solving Questions]

Answer the Question. The Question carry eight marks.   (1Qx8M=8M)

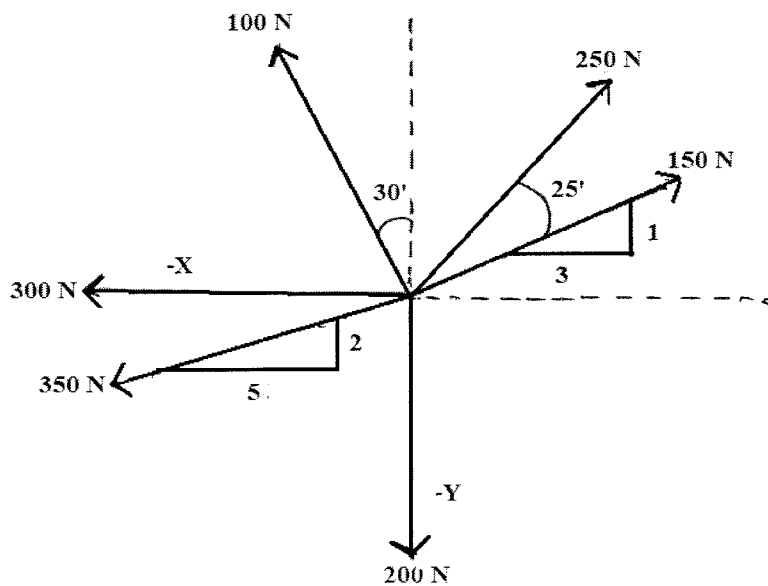7. Find the resultant force of coplanar concurrent force system as shown in Figure 02.

Figure 02.   **[8M] (C.O.NO2) [Knowledge]**

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: 1st Semester

Course Code: CIV101

Course Name: Elements of Civil Engineering

Date: 19 Nov. 2019

Time: 1 hour

Max Marks: 30

Weightage: 15%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Application type [Marks allotted]	Total Marks
			K and C	K and C	C	
1		1	3			3
2	1	1	3			3
3	1	1	3			3
4	1	1	3			3
5	1	1		5		5
6	1	1		5		5
7					8	8
	Total Marks		12	10	8	30

K =Knowledge Level   C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

SCHOOL OF ENGINEERING

SOLUTION

Semester: 1st Semester

Course Code: CIV101

Course Name: Elements of Civil Engineering

Date: 19 Nov. 2019

Time: 1 hour

Max Marks: 30

Weightage: 15%

Part A   (4Q x 3M = 12 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	**GPS (Global Positioning System)** 1. It is a global navigation satellite system that provides geolocation and time information to a GPS receiver anywhere on or near the Earth. 2. The GPS system consists of three basic elements: the space segment (Satellites), control segment (ground based stations), and user segment (GPS receivers).	3 marks	6 mins
2	1-c, 2-a, 3-b,	1 mark each	6 mins
3	$F_1 = 100N$ $F_2 = 150N$ $\theta = 45°$ Magnitude of Resultant $R = \sqrt{F_1^2 + F_2^2 + 2F_1 F_2 \cos\theta}$ $= \sqrt{100^2 + 150^2 + 2 \times 100 \times 150 \times \cos 45°}$ $= 231.76 N$	Formula 1M Calculation 2M	6 mins

4	• **Rainfall**- This is the most dominant form of precipitation in India and it denotes the water droplets with size ranging from 0.5-6mm. On the basis of intensity rainfall is classified as:	1 Mark each	6 mins

Inside cell 4:

• **Rainfall**- This is the most dominant form of precipitation in India and it denotes the water droplets with size ranging from 0.5-6mm. On the basis of intensity rainfall is classified as:

Intensity (mm/hr)	Type
0-2.5	Light
2.5-7.5	Medium
>7.5	Heavy

• **Snow**- It denotes ice crystal having a density of 0.1 gm/cc.

• **Drizzle**- These are fine droplets of water whose size is less than 0.5 mm and intensity is less than 1 mm/hr.

• **Glaze**- When droplets of water comes in contact with cold ground surface(approx. at 0°C) then the droplet of water is converted into ice which is called as glaze.

• **Sleet**- These are frozen droplets of transparent nature.

• **Hail**- These are lumps of ice whose size is more than 8mm.

1 Mark each — 6 mins

Part B

(2Q x 5M = 10 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
5	The common purposes for the construction of dams are as follows: 1. **Power generation:** Hydroelectric power is a major source of electricity in the world. Many countries have rivers with adequate water flow that can be dammed for power generation purposes. 2. **Water supply:** Many urban areas of the world are supplied with water abstracted from rivers pent up behind low dams or weirs. Other major sources include deep upland reservoirs contained by high dams across deep valleys. 3. **Stabilize water flow/irrigation:** Dams are often used to control and stabilize water flow, often for agricultural purposes and irrigation. 4. **Flood prevention:** Dams that are created for flood control. 5. **Land reclamation:** Dams are used to prevent ingress of water to an area that would otherwise be submerged, allowing its reclamation for human use. 6. **Water diversion:** Dams that are constructed for diverting water for various purposes. 7. **Recreation:** Dams built for any of the above purposes may find themselves displaced by the time of their original use. Nevertheless, the local community may have come to enjoy the reservoir for recreational and aesthetic reasons. 	2.5 M each	10 mins

| 6 | | $\sum fx - 1.5M$ $\sum fy - 1.5 M$ R-1M α -1M | 10 mins |
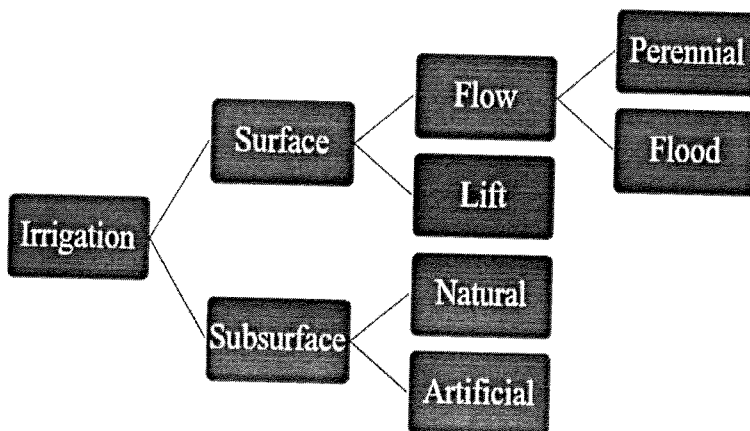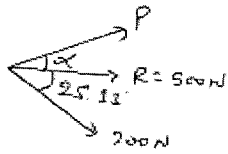
$$\sum F_y = 0 \quad , \quad \sum F_x = R$$

$$P \sin\alpha - 200 \sin 25.13' = 0$$

$$P \sin\alpha = 84.93 \rightarrow \textcircled{1}$$

$$\sum F_x = R$$

$$P \cos\alpha + 200 \cos 25.13 = 500$$

$$P \cos\alpha = 500 - 181.06$$

$$P \cos\alpha = 318.93 \rightarrow \textcircled{2}$$

$$Eq^n \textcircled{1} \div Eq^n \textcircled{2}$$

$$\frac{P \sin\alpha}{P \cos\alpha} = \frac{84.93}{318.93}$$

$$\alpha = \tan^{-1}\left(\frac{84.93}{318.93}\right)$$

$$\boxed{\alpha = 14.91}$$

Substituting either in $Eq^n \textcircled{2}$ or $Eq \textcircled{1}$

$$\boxed{P = 330.04 \, N}$$

Part C (1Q x 8M = 8 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question

7
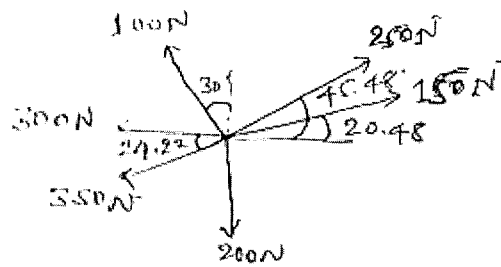
$\sum fx - 2.5M$
$\sum fy - 2.5M$
R-1.5M
α -1.5M

16 min

$\sum Fx = 150 \cos 20.48° + 250 \cos 45.48° + 300$

$\qquad - 100 \sin 30° - 350 \cos 24.22°$

$\qquad\qquad = -353.38 N$

$\sum Fy = 150 \sin 20.48 + 250 \sin 45.48° + 100$

$\qquad \cos 30° - 350 \sin 24.22° - 200$

$\qquad\qquad = -26.24 N$

$R = \sqrt{(-353.38)^2 + (-26.24)^2}$

$\qquad\qquad R = 354.35 N$

$\alpha = \tan^{-1}\left(\dfrac{-26.24}{-353.38}\right)$

$\qquad\qquad \therefore \alpha = 4.24°$

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20

Course Code: CIV 101

Course Name: ELEMENTS OF CIVIL ENGINEERING

Program & Sem: B.Tech. (Physics. Cycle) & I

Date: 31 December 2019

Time: 9:30 AM to 12:30 PM

Max Marks: 100

Weightage: 50%

Instructions:
(i) Read the all questions carefully and answer accordingly.
(ii) Use of Non-Programmable Scientific Calculator is permitted

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Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 05 marks. (6Qx5M=30M)

1. List the factors which affect the design of foundation (C.O.No.1) [Knowledge]

2. Two Forces of Magnitude 75N and 50N are perpendicular to each other. If the smaller force is along horizontal, determine magnitude of resultant and direction of resultant w.r.t. horizontal. (C.O.No.2) [Knowledge]

3. What are the objectives of surveying (C.O.No.3) [Knowledge]

4. a) Define Moment of a Force and with the help of an example, describe the calculation of moment of a force about a point. [3M]
   b) Define Couple and list the properties of Couple [2M]
   (C.O.No.4) [Knowledge]

5. List out any five qualities of good brick (C.O.No.5) [Knowledge]

6. Name any four types of beam and sketch any three out of them (C.O.No.6) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 10 marks. (4Qx10M=40M)

7. State and Prove Varignon's Theorem of Moments (C.O.No.4) [Comprehension]

8. a) Write the purpose of: (i) Shoulder (ii) Camber (iii) Kerb and (iv) Median in road. [4M]

   b) With a neat sketch, list the different component parts of a railway track. Briefly explain any two components. [6M]
   (C.O.No.3) [Knowledge]

9. Figure 9 shows a rope supporting a load of 4kN at B and another load of 'P' at C. If BC is inclined at 30° to horizontal, determine the load P. Also, find the tensile forces developed in different segments of the rope.
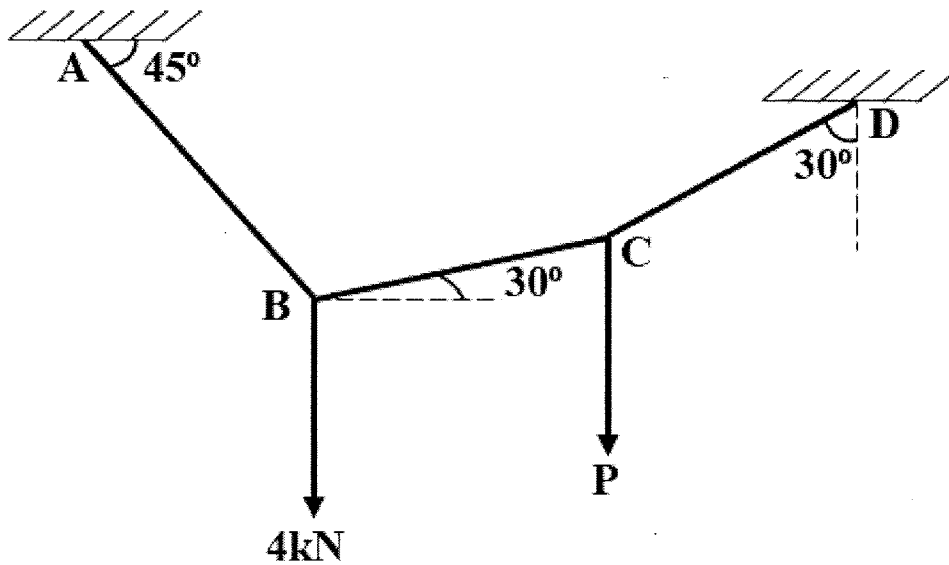
(C.O.No.6) [Comprehension]

Fig. 9

10. A body is subjected to forces as shown in Fig 10. Compute the resultant of force and point of application w.r.t. to point O.
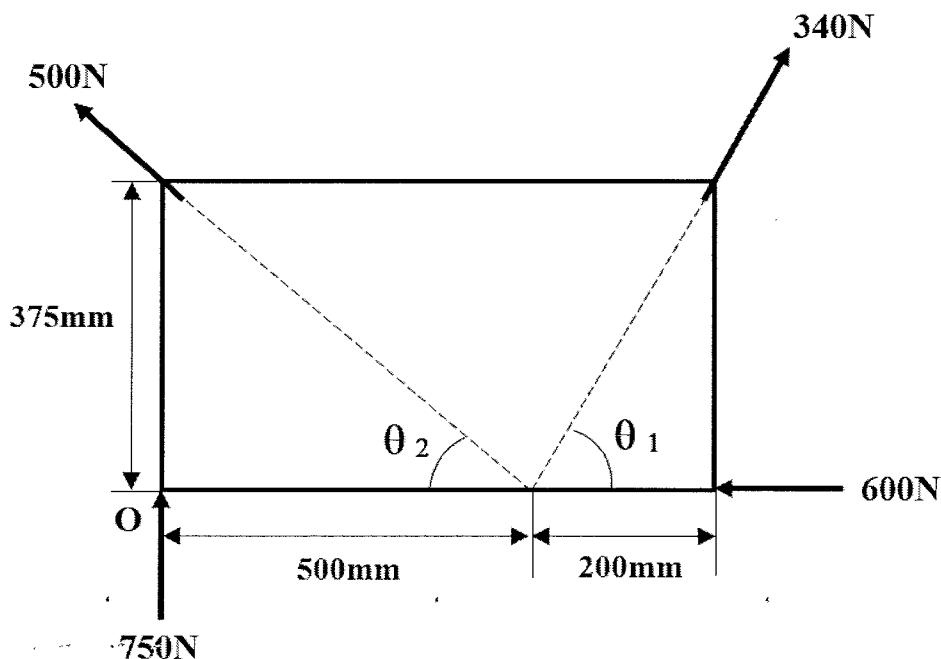

Fig. 10   (C.O.No.4) [Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries 15 marks.   (2Qx15M=30M)

11. a) Find the support reaction for a simply supported beam AB of Length 'L' subjected to a concentrated point load of 'W' at its mid-point.   [5M]

11 b) Find the support reactions for the beam loaded as shown in Fig. 11

Fig. 11

[10 M] (C.O.No.6) [Comprehension]

12. The cylinders P and Q weigh 20kN and 10kN. The corresponding diameters are 2.8m and 1.6m and are placed as shown in Fig. 12. Determine the reactions at A, B, C and D.
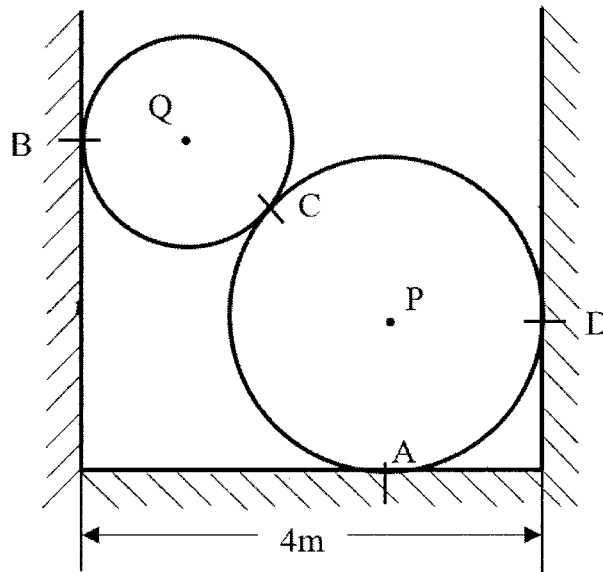

Fig. 12

(C.O.No.6) [Comprehension]

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester : Odd Semester: 2019 - 20

Course Code: CIV 101

Course Name: ELEMENTS OF CIVIL ENGINEERING

Program & Sem: B.Tech. (Phy. Cycle) & I Sem

Date: 31 Dec 2019

Time: 09:30AM to 12:30PM

Max Marks: 100

Weightage: 50 %

Instructions:

(i) Read the all questions carefully and answer accordingly.

(ii) Use of Non-Programmable Scientific Calculator is permitted

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 05 marks. (6Qx 5M = 30M)

1. List the factors which affect the design of foundation (C.O.No.1) [Knowledge]

2. Two Forces of Magnitude 75N and 50N are perpendicular to each other. If the smaller force is along horizontal, determine magnitude of resultant and direction of resultant w.r.t. horizontal. (C.O.No.2) [Knowledge]

3. What are the objectives of surveying (C.O.No.3) [Knowledge]

4. a) Define Moment of a Force and with the help of an example, describe the calculation of moment of a force about a point. [3M]
   b) Define Couple and list the properties of Couple [2M]
   (C.O.No.4) [Knowledge]

5. List out any five qualities of good brick (C.O.No.5) [Knowledge]

6. Name any four types of beam and sketch any three out of them (C.O.No.6) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 10 marks. (4Qx10M=40M)

7. State and Prove Varignon's Theorem of Moments (C.O.No.4) [Comprehension]

8 a) Write the purpose of: (i) Shoulder (ii) Camber (iii) Kerb and (iv) Median in road. [4M]

   b) With a neat sketch, list the different component parts of a railway track. Briefly explain any two components. [6M]
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9. Figure 9 shows a rope supporting a load of 4kN at B and another load of 'P' at C. If BC is inclined at 30° to horizontal, determine the load P. Also, find the tensile forces developed in different segments of the rope.
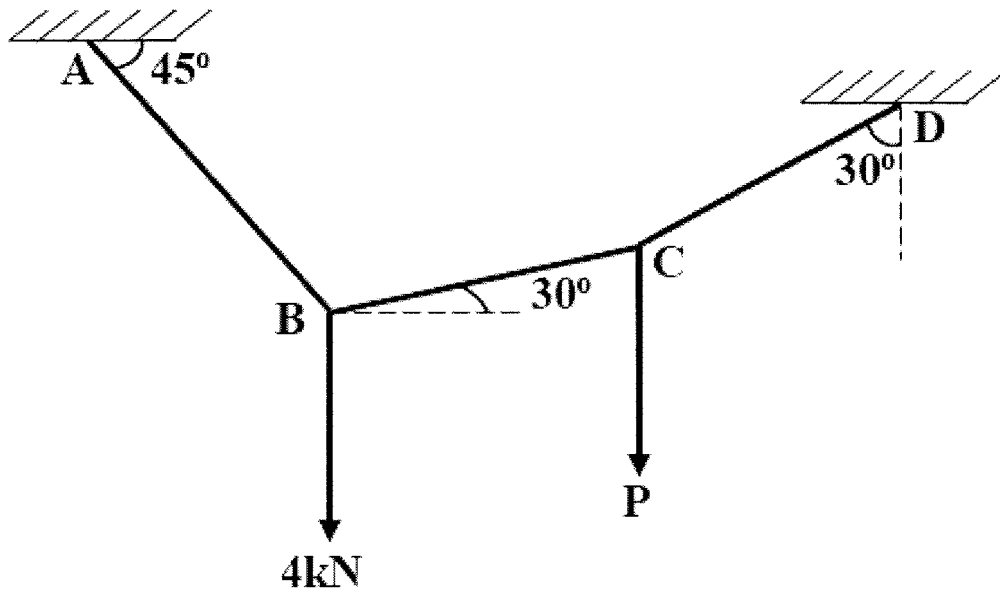
<div align="right">(C.O.No.6) [Comprehension]</div>

Fig. 9

10. A body is subjected to forces as shown in Fig 10. Compute the resultant of force and point of application w.r.t. to point O.
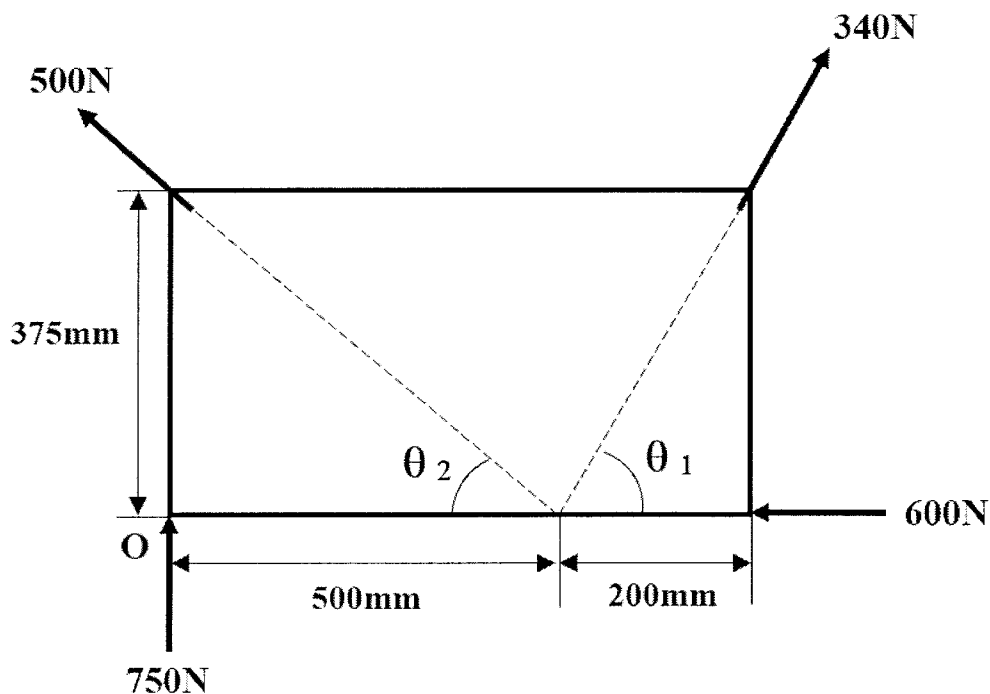

Fig. 10   (C.O.No.4) [Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries 15 marks.   **(2Qx15M=30M)**

11. a) Find the support reaction for a simply supported beam AB of Length 'L' subjected to a concentrated point load of 'W' at its mid-point.   [5M]

11 b) Find the support reactions for the beam loaded as shown in Fig. 11
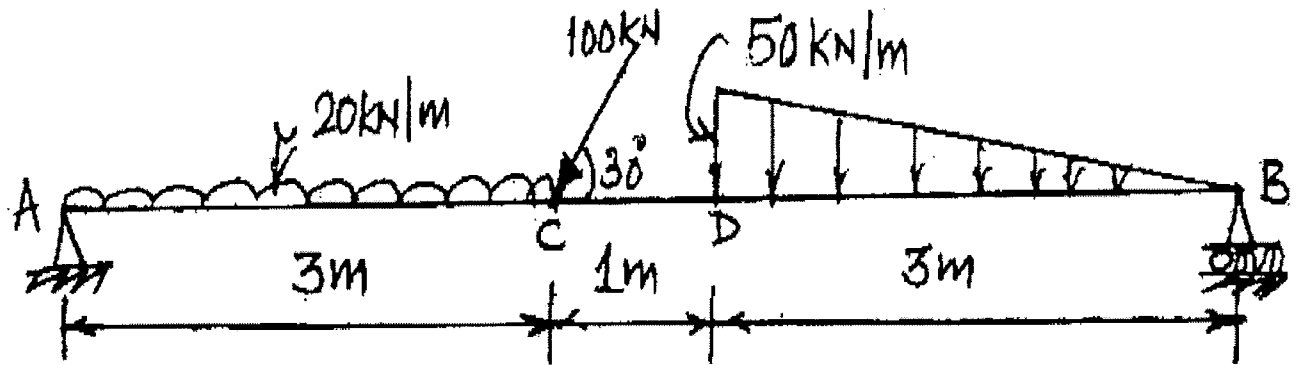

Fig. 11

[10 M] (C.O.NO.6) [Comprehension]

12. The cylinders P and Q weigh 20kN and 10kN. The corresponding diameters are 2.8m and 1.6m and are placed as shown in Fig. 12. Determine the reactions at A, B, C and D.
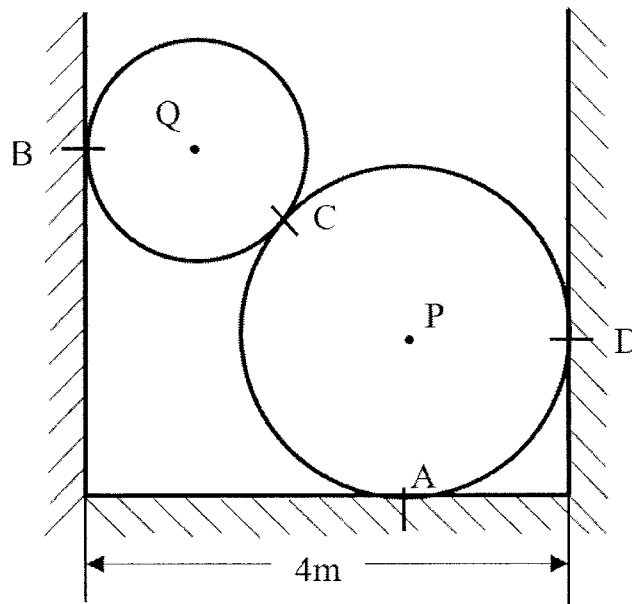

Fig. 12

(C.O.NO.6) [Comprehension]

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q. NO.	C.O. NO. (% age of CO)	Unit/Module Number/Unit/ Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	C	
1	C.O. NO. 1	Module - 1	5			5
2	C.O. NO. 2		5			5
3	C.O. NO. 3	Module - 2	5			5
4	C.O. NO. 4		5			5
5	C.O. NO. 5	Module - 3	5			5
6	C.O. NO. 6		5			5
7	C.O. NO. 4	Module - 2		10		10
8	C.O. NO. 3			10		10
9	C.O. NO. 6	Module - 3		10		10
10	C.O. NO. 4	Module - 2		10		10
11	C.O. NO. 6	Module - 3			15	15
12	C.O. NO. 6				15	15
	Total Marks		30	40	30	100

K =Knowledge Level   C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Comment:

SCHOOL OF ENGINEERING

SOLUTION

Semester: Odd Sem. 2019-20

Course Code: CIV 101

Course Name: ELEMENTS OF CIVIL ENGINEERING
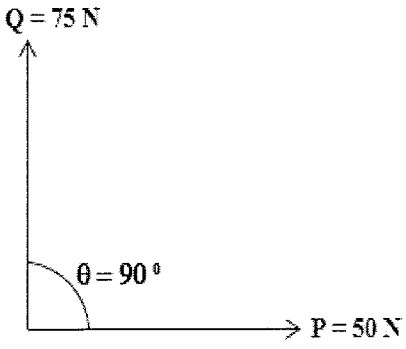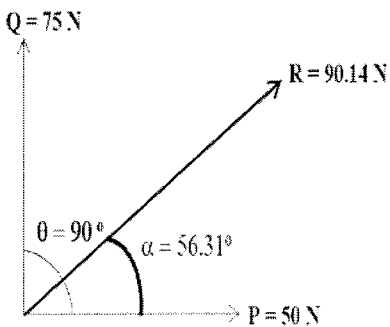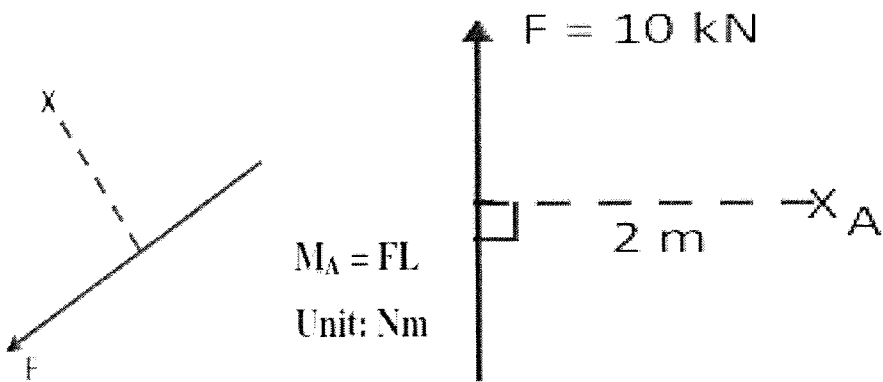
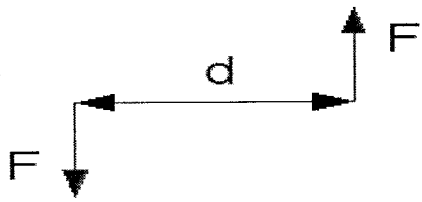**Program & Sem:** B.TECH. & I SEM

Date: 31.12.2019

Time: 3 HRS

Max Marks: 100
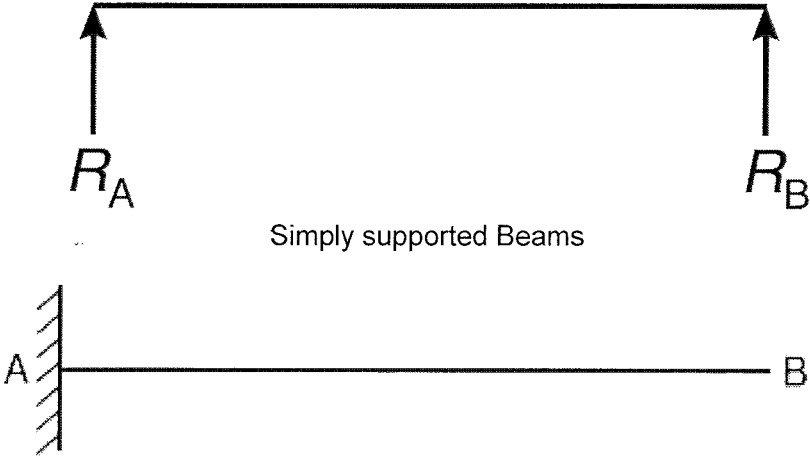
Weightage: 50%

Part A (6Q x 5M = 30Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	The following factors affect the design of Foundation: • Soil types and ground water table conditions • Structural requirements • Construction requirements • Site condition and environmental factor • Economy	1 Mark for each point (05 x 01 M = 05 Marks)	5 Minutes
2	$Q = 75\ N$ $P = 50N$ $Q = 75N$ $\theta = 90^\circ$ (Perpendicular) $R = \sqrt{P^2 + Q^2 + 2\,PQ\cos\theta}$ $\theta = 90^\circ$ $R = \sqrt{50^2 + 75^2 + (2*50*75\cos 90)}$ $\longrightarrow P = 50\ N$ **Magnitude of Resultant, R = 90.14 N** Direction of Resultant w.r.t. smaller force (P), $\alpha = \tan^{-1}\left(\dfrac{Q\sin\theta}{P + Q\cos\theta}\right)$ $\alpha = \tan^{-1}\left(\dfrac{75\sin 90}{50 + 75\cos 90}\right)$ **Direction of Resultant w.r.t. P, $\alpha = 56.3^\circ$** $Q = 75\ N$ $R = 90.14\ N$ $\theta = 90^\circ$ $\alpha = 56.31^\circ$ $\longrightarrow P = 50\ N$	Figure & Data – 1M Magnitude of Resultant – 2M Direction of Resultant – 2M	10 Minutes

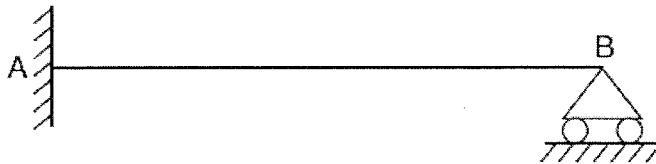|			
3	Objectives of Surveying are as follows: 1. The main object of surveying is to prepare a map or plan to show the relative positions of the objects on the surface of the earth. 2. To determining the boundaries of land. 3. It is very useful for the purpose of designing projects, such as dams, canals, roads, railways etc. 4. The successful completion of any engineering project mainly depends upon the accurate surveying. 5. To determine area and Volume.	1 Mark for each point (05 x 01 M = 05 Marks)	5 Minutes
4	i) It is the capacity of a force to produce rotational motion. In other words moment of a force is its rotating capacity Moment of a force about any point is given by the product of magnitude of force and perpendicular distance between the line of action of a force and the point about which moment is considered. $F = 10\ kN$ $M_A = FL$ Unit: Nm **Moment of 10kN Force about A, $M_A = 10 \times 2$** **$M_A = +\ 20kN\text{-}m$** **$M_A = 20kN\text{-}m$ (Clockwise)** ii) Two forces equal in magnitude, opposite in direction separated by a distance form a couple (or) Two equal, opposite and parallel forces constitute a couple as shown in figure. F d F **Properties of couple** 1. Two equal and opposite parallel forces are required to form a couple. 2. Resultant of the forces of couple is zero	Definition of Moment – 1 Mark Calculation of Moment with example – 2 Mark Definition of Couple – 1 Mark Properties of Couple – 1 Mark	5 Minutes 5 Minutes

|			
5	The good bricks which are to be used for the construction of important structures should possess the following qualities: 1. The bricks should be table-moulded, well burnt in kilns, copper-colored, free from cracks and with sharp and square edges. The colour should be uniform and bright. 2. The bricks should be uniform in shape and should be of standard size. 3. The bricks should give a clear metallic ringing sound when struck with each other. 4. The bricks when broken or fractured should show a bright homogeneous and uniform compact structure free from voids. 5. The bricks should be sufficiently hard. No impression should be left on brick surface, when it is scratched with finger nail. 6. The bricks should not break into pieces when dropped flat on hard ground from a height of about one meter. 7. The bricks should have low thermal conductivity and they should be sound proof. 8. The bricks, when soaked in water for 24 hours, should not show deposits of white salt when allowed to dry in shade. 9. No bricks should have the crushing strength below 5.50 N/mm^2. *(Note: Student is expected to write any five qualities)*	1 Mark for each quality (05 x 01 M = 05 Marks)	5 Minutes

6	**Types of Beams:**
	
	  1. Simply supported Beam 2. Cantilever Beam
	  3. Overhanging Beam 4. Fixed Beam
	  5. Continuous Beam 6. Propped Cantilever Beam
	  7. One end hinged other on roller
	
	*(**Note:** Student is expected to write the names of **any 4 types only**)*
	
	Sketch of Beams
	
	Simply supported Beams
	
	Cantilever Beams
		List of any four types of beams – 02 Marks	5 Minutes
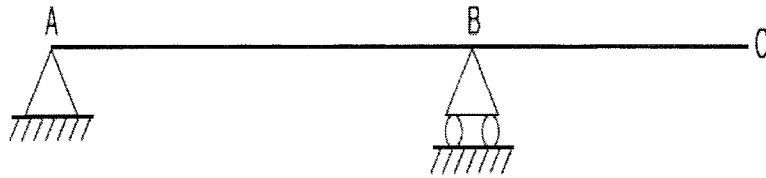
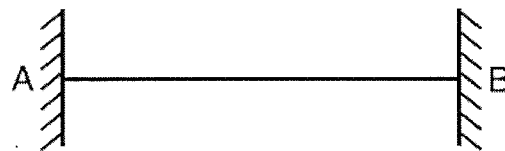Overhanging Beams
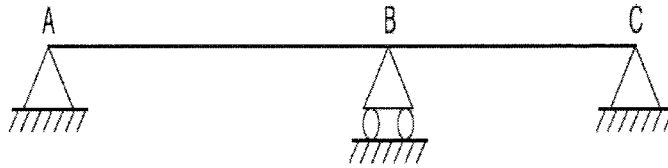
Continuous Beams

Propped Cantilever Beams
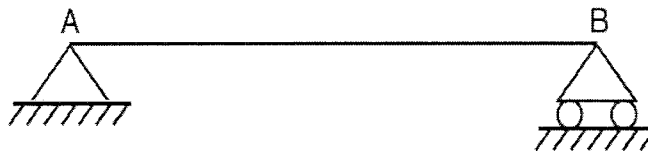
One end hinged and other on roller

Fixed Beams

*(Note: Student is expected to sketch **any 3 types** only)*

Sketch of any three types of beams – 03 Marks

Part B   (4Q x 10M = 40Marks)

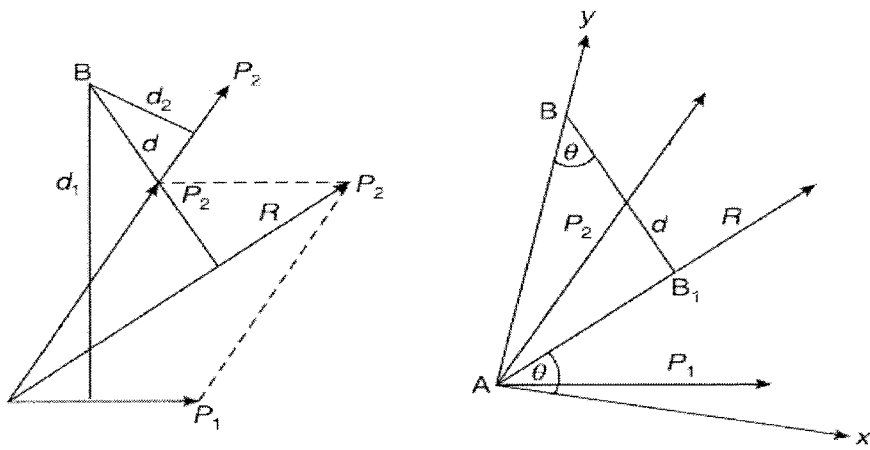| Q No	Solution	Scheme of Marking	Max. Time required for each Question
7	**Statement:** Varignon's theorem of Moments states that "the algebraic sum of the moments of individual forces of a force system about a point is equal to the moment of their resultant about the same point". Let R be the resultant of forces P_1 and P_2 and B be the moment center. Let d, d_1 and d_2 be the moment arms of forces R, P_1 and P_2, respectively, from the moment center B as shown in Figure below. We have to prove that, **Rd = P_1d_1 + P_2d_2**	Statement of Varignon's theorem – 1 Mark 1 Mark	15 Minutes

Proof: Join AB and consider it as the y-axis and draw the x-axis at right angles to it at A.

Let θ be the angle made by R with the x-axis and note that the same angle is formed with the y-axis by the perpendicular to R from B and note this point as B_1.

We know that,

$$Rd = R \times AB \cos \theta$$

$$= AB \times R \cos \theta$$

$$\text{or } Rd = AB \times Rx \qquad \dots\dots\dots\dots\dots\dots\dots(1)$$

where Rx is the component of R in the x-direction.

Similarly, if P_{1x} and P_{2x} are the components of P_1 and P_2 in the x-direction, respectively, then,

$$P_1d_1 = AB \times P_{1x} \qquad \dots\dots\dots\dots\dots\dots (2)$$

$$\text{and} \qquad P_2d_2 = AB \times P_{2x} \qquad \dots\dots\dots\dots\dots\dots (3)$$

Adding equations (2) and (3), we get

$$P_1d_1 + P_2d_2 = AB(P_{1x} + P_{2x})$$

$$\text{or } P_1d_1 + P_2d_2 = AB \times R_x \qquad \dots\dots\dots\dots\dots\dots (4)$$

Since the sum of x-components of the individual forces is equal to the x-component of the resultant R, from equations (1) and (4), we can conclude that

$$Rd = P_1d_1 + P_2d_2$$

|		
a) (i) Shoulder is provided to act as an extra lane to the road during emergency. It is also provided to act as a parking space for vehicles which break down during journey.	1 Mark	
(ii) Camber is a transverse slope provided to the road to drain off surface water.	1 Mark	10 Minutes
(iii) Kerb is a boundary between pavement and footpath or median provided to mark the road boundary and also to provide lateral support to the pavement.	1 Mark	
(iv) Median is provided to segregate the traffic in opposite direction, avoid head on collision and reduce the gleaming effect due to the headlight at night.	1 Mark	
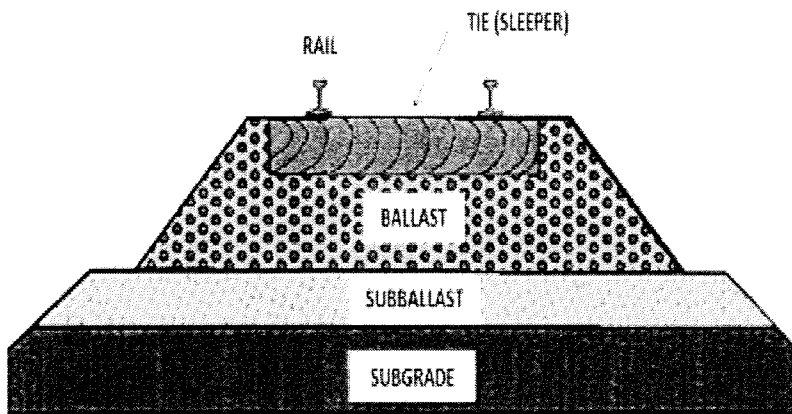
b) Sketch:

The different components of railway track are as follows: 1. Rails 2. Sleeper 3. Ballast 4. Sub-Ballast 5. Subgrade	Sketch – 1.5 Marks List of components of railway track – 2.5 Marks (0.5 Mark for each)	10 Minutes
Description/Explanation of any one component of railway track: **Rails** • Rails are the members of the track laid in two parallel lines to provide an unchanging, continuous, and level surface for the movement of trains. • Rails provide a continuous and level surface for the movement of trains. • They carry out the function of transmitting the load to a large area of the formation through sleepers and the ballast.	Explanation of any one component component - 02 Marks	

8

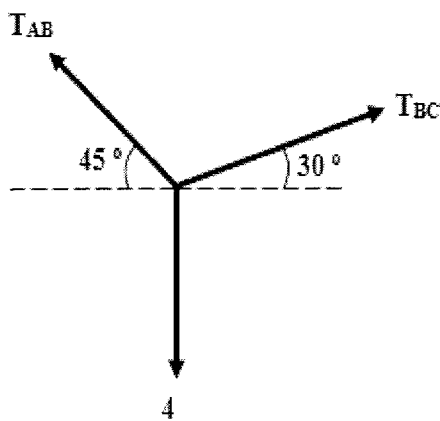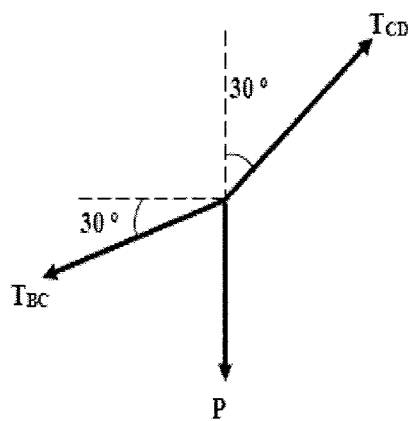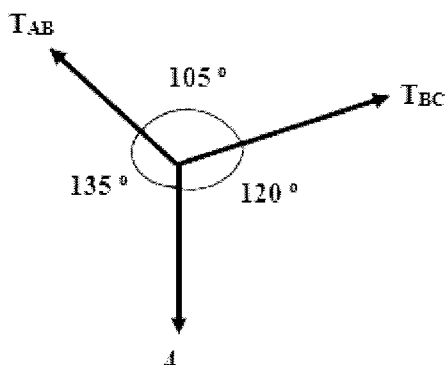|				
	Sleeper • Sleepers are the transverse ties that are laid to support the rails. • They have an important role in the track as they transmit the wheel load from the rails to the ballast. • Sleepers hold the rails in their correct gauge and alignment. • It gives a firm and even support to the rails. **Ballast** • Ballast is a layer of broken stones, gravel, moorum, or any other granular material placed and packed below and around sleepers for distributing load from the sleepers to the formation. • It provides drainage as well as longitudinal and lateral stability to the track. **Subgrade** • Subgrade is the naturally occurring soil which is prepared to receive the ballast. • The prepared flat surface, which is ready to receive the ballast, along with sleeps and rails, is called the formation. • The formation or subgrade is an important constituent of the track, as it supports the entire track structure. *(Note: Student is expected to **any 1 component only**)*			
9	**Free body diagram** Applying Lami's theorem at B $$\frac{T_{AB}}{\sin 120} = \frac{4}{\sin 105} = \frac{T_{BC}}{\sin 135}$$ **T_{AB} = 3.59 kN** **T_{BC} = 2.93 kN**		Free Body diagram at pt. B and C – 3 Marks Determination of Forces T_{AB} and T_{BC} – 3 Marks	20 Minutes
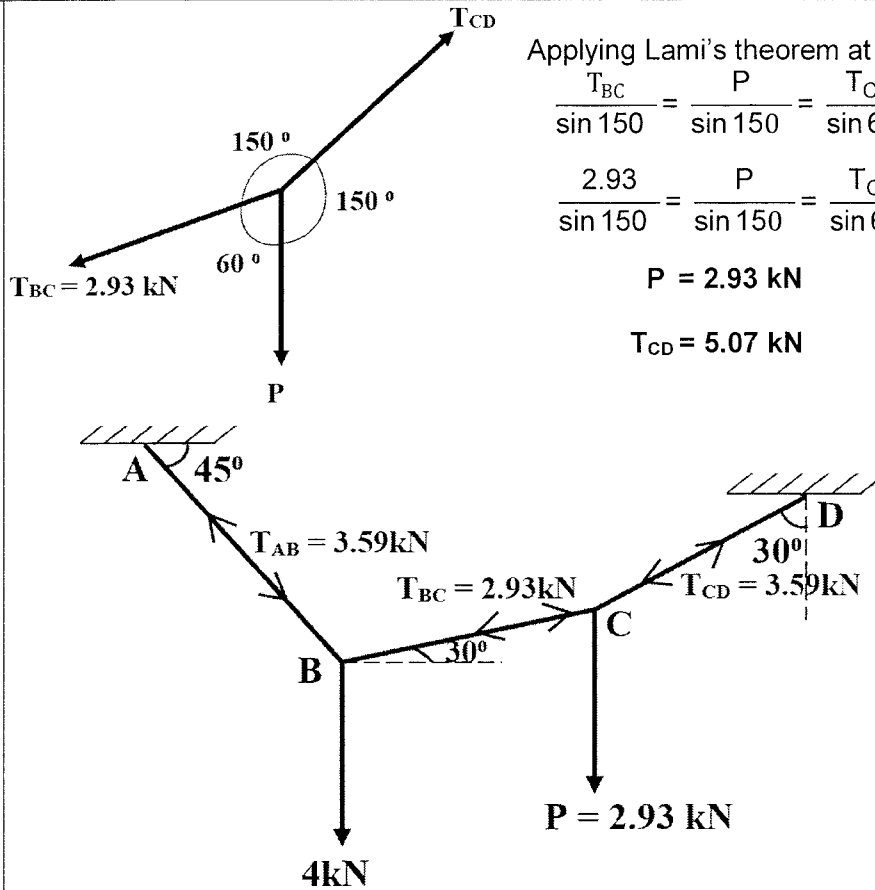
Applying Lami's theorem at C

$$\frac{T_{BC}}{\sin 150} = \frac{P}{\sin 150} = \frac{T_{CD}}{\sin 60}$$

$$\frac{2.93}{\sin 150} = \frac{P}{\sin 150} = \frac{T_{CD}}{\sin 60}$$
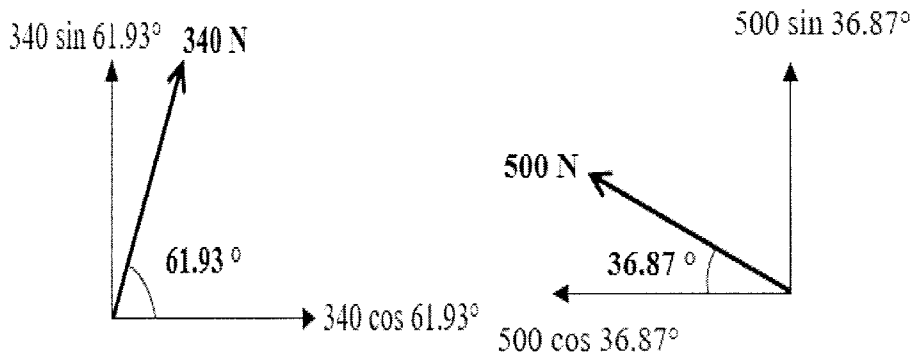
P = 2.93 kN

T_{CD} = 5.07 kN

| Determination of Forces T_{CD} and P – 4 Marks |

$\theta_1 = \tan^{-1}(375/200) = 61.93^{\circ}$

$\theta_2 = \tan^{-1}(375/500) = 36.87^{\circ}$

| Determination of Angles θ_1 and θ_2 – 2 Marks |

20 Minutes

$\sum F_X = -600 - 500\cos 36.87 + 340 \cos 61.93$

$\sum F_X = -840N$

$\sum F_Y = 750 + 500\sin 36.87 + 340 \sin 61.93$

$\sum F_Y = +1350 N$

Magnitude of Resultant force, $R = \sqrt{\sum Fx^2 + \sum Fy^2}$

$$R = \sqrt{(-840)^2 + (1350)^2}$$

Magnitude of Resultant, R = 1590 N

| Determination of Magnitude of Resultant – 2 Marks |

10

Direction of Resultant, $\theta = \tan^{-1}\left(\dfrac{\Sigma F_y}{\Sigma F_x}\right)$ $\theta = \tan^{-1}\left(\dfrac{1350}{-840}\right)$ $\theta = 58.11°$ $\Sigma M_O = (750 \times 0) + (600 \times 0) + (500\sin 36.87 \times 0) - (500\cos 36.87 \times 375)$ $\qquad + (340 \cos 61.93 \times 375) - (340 \sin 61.93 \times 700)$ $\Sigma M_O = -149.594 \times 10^3 \text{ N-mm}$ $d_O = \left\|\dfrac{\Sigma M_O}{R}\right\| \quad ; \quad d_O = \left\|\dfrac{-149.594 \times 10^3}{1590}\right\| \; ; \; d_O = 94.08 \text{ mm}$ $x_O = \left\|\dfrac{\Sigma M_O}{\Sigma F_Y}\right\| \quad ; \quad x_O = \left\|\dfrac{-149.594 \times 10^3}{1350}\right\| \; ; \; x_O = 110.81 \text{ mm}$ $y_O = \left\|\dfrac{\Sigma M_O}{\Sigma F_X}\right\| \quad ; \quad y_O = \left\|\dfrac{-149.594 \times 10^3}{-840}\right\| \; ; \; y_O = 178.09 \text{ mm}$ **d = 94.1mm** **X intercept = 110.8mm** **Y intercept = 178.1mm**	Determination of Direction of Resultant – 1 Mark Determination of Moment of Forces abt. pt. O - 2 Marks 1 Mark 1 Mark 1 Mark	

Part C (2Q x 15M = 30Marks)

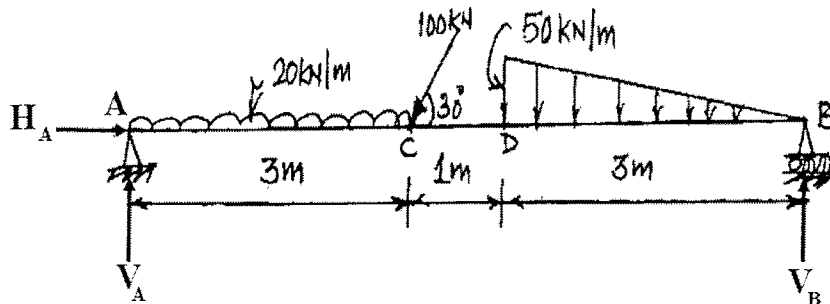| Q No	Solution	Scheme of Marking	Max. Time required for each Question
11	a) $\Sigma F_y = 0; \; \Sigma F_y = R_A - W + R_B$ $0 = R_A + R_B - W$ $R_A + R_B = W$ $\Sigma M_A = 0; \; \Sigma M_A = (W \times L/2) - (R_B \times L)$ $0 = (W.L)/2 - R_B . L$ $R_B . L = (W.L)/2;$ $R_B = W/2$	Fig. – 1 Mark Eq. for $R_A + R_B$ – 1 Mark Determination of R_B - 2 Marks	5 Minutes

$R_A + R_B = W$

$R_A = R_B - W$

$R_A = (W/2) - W$

$R_A = W/2$

| | | Determination of R_A - 1 Mark | |

b)

$\sum Fx = 0,$

$H_A - 100\cos 30 = 0$

$H_A = 86.6 \text{ kN}$

For Equilibrium $\sum M_A = 0$

Taking moment about point A

$\sum M_A = (H_A \times 0) + (V_A \times 0) + 20 \times 3 \times (3/2) + (100 \cos 30 \times 0)$

$\quad\quad\quad + (100 \sin 30 \times 3) + (1/2) \times 50 \times 3 \times (4 + [3/3]) - (V_B \times 7)$

$0 = +90 + 150 + 375 - 7 V_B$

$7 V_B = 615$

$V_B = 87.86 \text{ kN}$

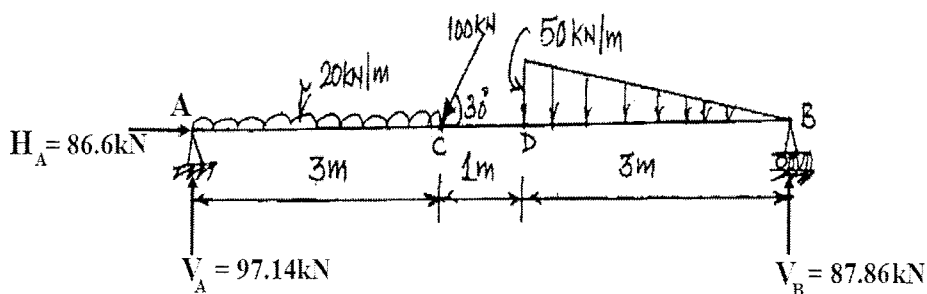$\sum Fy = 0,$

$\sum Fy = + V_A - (20 \times 3) - 100 \sin 30 + (1/2) \times 50 \times 3 + V_B$

$0 = + V_A - 60 - 50 - 75 + 87.86$

$V_A = 185 - 87.86$

$V_A = 97.14 \text{kN}$

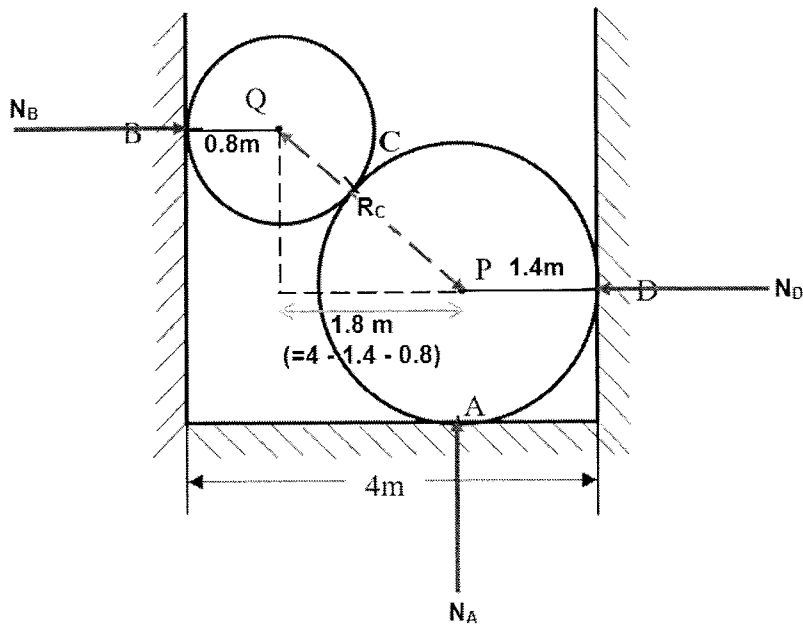| Section	Note
Fig. showing support reactions – 1 Mark	20 Minutes
Det. of H_A – 2 Marks	
Det. of V_B – 4 Marks	
Det. of V_A – 3 Marks	

12

Determination of angles for reaction force at C

$$\cos \theta = \left(\frac{1.8}{2.2}\right)$$

$$\theta = \cos^{-1}\left(\frac{1.8}{2.2}\right)$$

$$\theta = 35.1°$$

Free body diagram (FBD)

FBD for Sphere Q   FBD for Sphere P

Applying Lami's theorem for Sphere Q

$$\frac{R_C}{\sin 90} = \frac{10}{\sin 144.9} = \frac{N_B}{\sin 125.1}$$

$$R_C = 17.39 \text{ kN}$$

$$N_B = 14.23 \text{ kN}$$
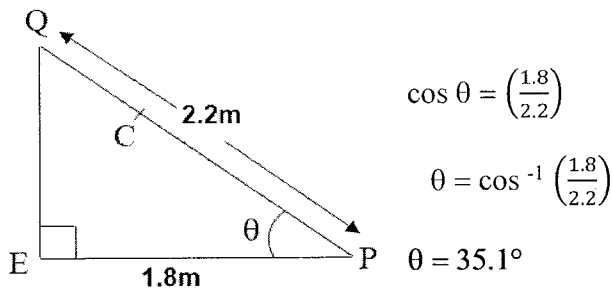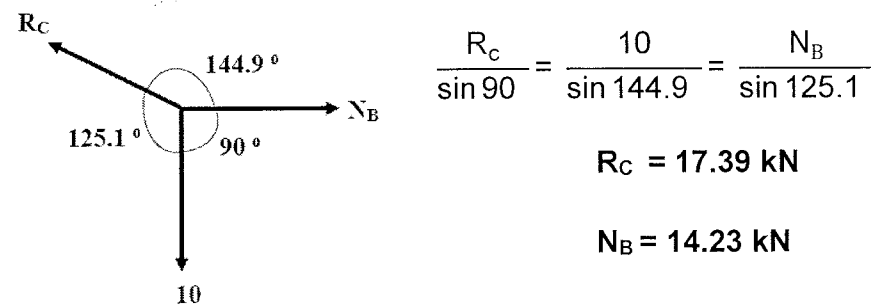
	30 Minutes
	Det. of Angle for Reaction force at C – 2 Marks
	FBD of Sphere Q – 2 Marks
	FBD of Sphere P – 2 Marks
	Det. of R_C – 2 Marks
	Det. of N_B – 2 Marks

Using Equilibrium conditions for Sphere P
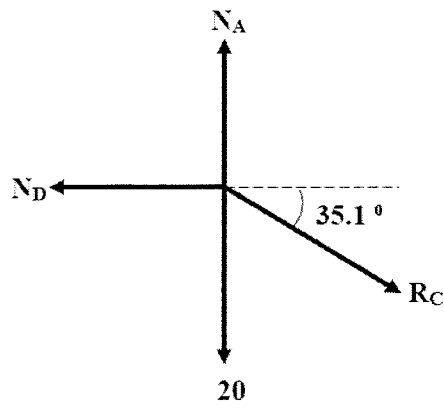
$\sum F_X = 0$

$\sum F_X = N_D - R_C \cos 35.1$

$0 = N_D - 17.39 \cos 35.1$

$N_D = 14.23 \text{ kN}$

$\sum F_Y = 0$

$\sum F_Y = N_A - 20 - R_C \sin 35.1$

$0 = N_A - 20 - 17.39 \sin 35.1$

$N_A = 30 \text{ kN}$

Det. of N_D – 2.5 Marks

Det. of N_A – 2.5 Marks