Roll No.													

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem: Odd Sem 2019-20

Course Code: MEC 206

Course Name:MECHANICS OF SOLIDS

Program & Sem: B.TECH (MEC) & III

Date: 01.09.2019

Time: 11.00AM to 12.00PM

Max Marks: 40

Weightage:20%

Instructions:

(i) Answer all the Questions
(ii) Non Programmable calculators are only allowed
(iii) Read the Questions carefully before attempting

Part A [Memory Recall Questions]

Answer both the Questions. Each Question carries eight marks. (2Qx8M=16M)

1. State the Hooke's Law. Neatly draw the stress strain diagram for Mild steel Indicating all points and Zones on it and explain them.
(C.O.NO.1)[Knowledge]

2. List the different types of Beams, Loads and Supports with suitable diagrams.
(C.O.NO.2) [Knowledge]

Part B [Thought Provoking Questions]

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

3. Tejas Company is into manufacturing concrete beams. They had to manufacture a cantilever beam which carries point loads as shown in Fig.1.Draw the shear force and Bending moment diagrams, so that the beam should be able to withstand the loads shown in the Fig.1.

(C.O.NO.2) [Comprehension]

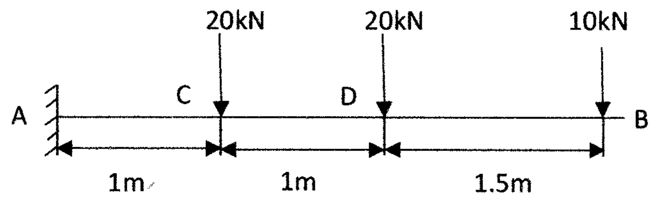


Fig.1

Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries eight marks. (2Qx8M=16M)

5. A steel rail is 12 m long and is laid at a temperature of 18°C. The maximum temperature expected is 40°C.

   (i) Estimate the minimum gap between two rails to be left so that the temperature stresses do not develop.
   (ii) Calculate the temperature stresses developed in the rails, if:
      (a) No expansion joint is provided.
      (b) If a 1.5 mm gap is provided for expansion.
   (iii) If the stress developed is 20 N/mm^2, what is the gap provided between the rails?

   Take $E = 2 \times 10^5$ N/mm^2 and $\alpha = 12 \times 10^{-6}$/°C. (C.O.NO.1)[Application]

6. The following data refer to a mildsteel specimen tested in a laboratory.
   Diameter of specimen=25mm
   Gauge Length=200mm
   Extension under a load of 20kN=0.04mm
   Load at Yield point=150kN
   Maximum Load=225kN.
   Determine: i) Young's Modulus
   ii) Yield Stress
   iii) Ultimate stress

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

SCHOOL OFENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Date: 01-09-2019

Semester: III

Time: 11.00 am to 12.00 pm

Course Code: MEC-206

Max Marks: 40

Course Name: MECHANICS OF SOLIDS

Weightage: 20%

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			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1	CO-1	MODULE-1/ Stress & Strain	8									8
2	CO-2	MODULE-2 /Shear Stress	8									8
3	CO-2	MODULE-2 /Shear Stress				8						8
4	CO-1	MODULE-1/ Stress & Strain				8						8
5	CO-1	MODULE-1/ Stress & Strain							8			8
6	CO-1	MODULE-1/ Stress & Strain							8			8
	Total Marks		16			8			16			40

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
Dr. B. S. PRAVEEN KUMAR_____ Sign_________]

Reviewers' Comments

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Semester: ODD

Course Code: MEC-206

Course Name: MECHANICS OF SOLIDS

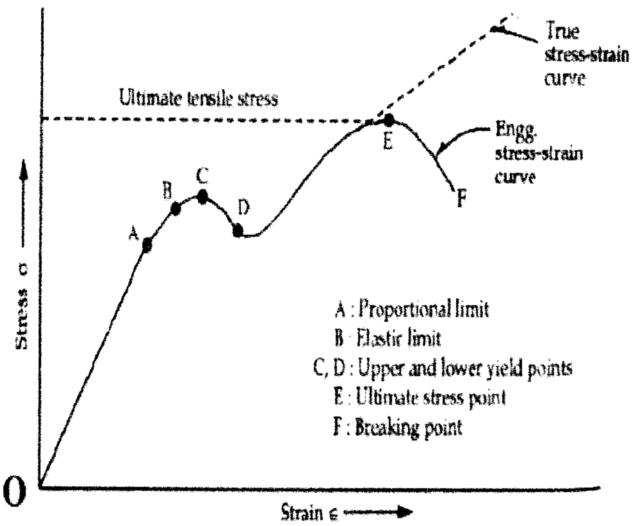
Date:01-09-2019

Time:

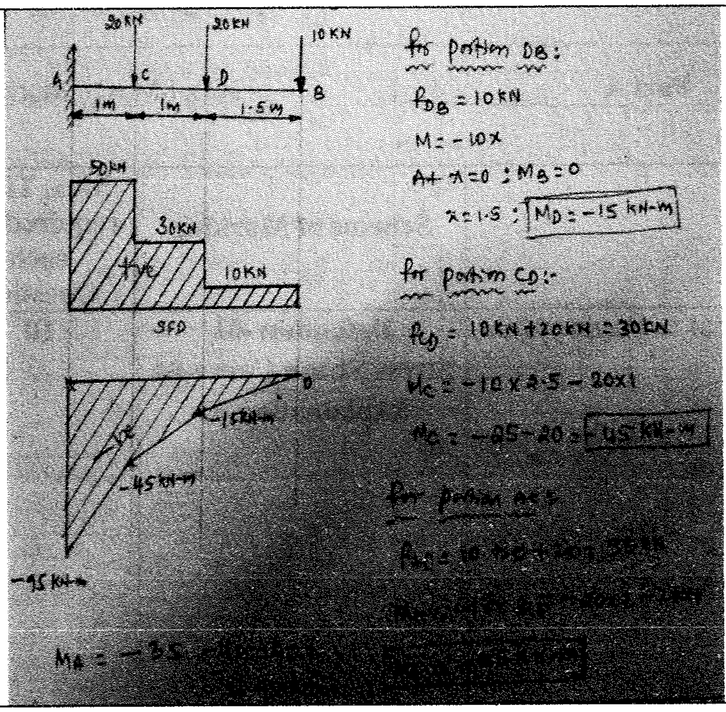
Max Marks: 40

Weight age: 20%

Part A (2Q x 8M =16 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Hooke's Law: Stress is proportional to Strain within Elastic Limit. 	**Definition -01** **Stress Strain Curve-04** **Explaination-03**	**10**
2	**Types of Beams:** Simply Supported Beam. Fixed Beam. Cantilever Beam. Continuously Supported Beam. **Types of Loads:** Concentrated Or Point Load Uniformly Distributed Load Uniformly Varying Load **Types of Supports:** Roller supports, Pinned support, Fixed support	**Beams with Figs-03** **Loads with Figs:03** **Supports with Figs:02**	**10**

Part B (1Q x 8M = 08 Marks)

<table>
<tr><th>Q No</th><th>Solution</th><th>Scheme of Marking</th><th>Max. Time required for each Question</th></tr>
<tr><td>3</td><td>
</td><td>SFD-3M
BMD-3M
Moments-2M</td><td>15</td></tr>
<tr><td>4</td><td>σ = 142.85 N/mm^2
A = 980mm^2
d = 95.62mm
t = 3.169mm</td><td>Stress----2M
Area-------2M
Diameter-----2M
Thickness-----2M</td><td>15</td></tr>
</table>

Part C (2Q x 8M = 16Marks)

<table>
<tr><th>Q No</th><th>Solution</th><th>Scheme of Marking</th><th>Max. Time required for each Question</th></tr>
<tr><td>5</td><td>(i) The free expansion of the rails
$= \alpha tL = 12 \times 10^{-6} \times (40 - 18) \times 12.0 \times 1000$
$= 3.168$ mm
∴ Provide a minimum gap of 3.168 mm between the rails, so that temperature stresses do not develop.
(ii) (a) If no expansion joint is provided, free expansion prevented is equal to 3.168 mm.
i.e. $\Delta = 3.168$ mm
∴ $\frac{PL}{AE} = 3.168$
∴ $p = \frac{P}{A} = \frac{3.168 \times 2 \times 10^5}{12 \times 1000} = 52.8$ N/mm²
(b) If a gap of 1.5 mm is provided, free expansion prevented $\Delta = \alpha tL - \delta = 3.168 - 1.5 = 1.668$ mm.
∴ The compressive force developed is given by $\frac{PL}{AE} = 1.668$
or $p = \frac{P}{A} = \frac{1.668 \times 2 \times 10^5}{12 \times 1000} = 27.8$ N/mm²
(iii) If the stress developed is 20 N/mm², then $p = \frac{P}{A} = 20$
If δ is the gap, $\Delta = \alpha tL - \delta$
∴ $\frac{PL}{AE} = 3.168 - \delta$
i.e. $20 \times \frac{12 \times 1000}{2 \times 10^5} = 3.168 - \delta$
∴ $\boldsymbol{\delta} = 3.168 - 1.20 = \mathbf{1.968}$ mm</td><td>Free Expansion :2M
Stress:3M
Finding delta-3M</td><td>20</td></tr>
<tr><td>6</td><td>$\sigma = 40.744$ N/mm²
$\epsilon = 2X10^{-4}$
E= $2.0372X10^5$ N/mm²
Yield Stress= 305.58 N/mm²
Ultimate Stress=458.366 N/mm²</td><td>Stress-3M
Strain—1M
Youngs Modulus—2M
U Stress-2M</td><td>10</td></tr>
</table>

Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem: Odd Sem 2019-20
Course Code: MEC 206
Course Name: MECHANICS OF SOLIDS
Program & Sem: B.Tech (MECH) & III Sem

Date: 19.11.2019
Time: 11.00 AM to 12.00 PM
Max Marks: 40
Weightage: 20%

Instructions:

(i) Answer all the Questions.
(ii) Non Programmable calculators are only allowed.
(iii) Read the Questions carefully before attempting.

Part A [Memory Recall Questions]

Answer both the Questions. Each question carries eight marks. (2Qx8M=16M)

1. Write the assumptions in simple theory of bending. Obtain the Bending moment equation with usual notations
$$\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$$
(C.O.NO.2)[Comprehension]

2. Derive torsion equation. Mention the assumptions in theory of pure torsion.
(C.O.NO.3)[Comprehension]

Part B [Thought Provoking Questions]

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

3. Rajesh and CO is into manufacturing concrete beams. They had to manufacture a cantilever beam having I section (shown in figure 1), with unequal flanges. The upper and the lower flanges are to be [200 mm X 14 mm] and [100mm X 14 mm] respectively. The web should be [14mm X 250 mm]. The cantilever would be subjected to UDL of magnitude of 4 kN/m over its entire length and expected to carry a point load of W at the free end as shown in Fig.1.The material used by them has an yield stress of 330 MPa. The FOS was kept at 2.They need to find the maximum load (W) that can be applied so that the beam sections are safe.
(C.O.NO.2)[Comprehension]

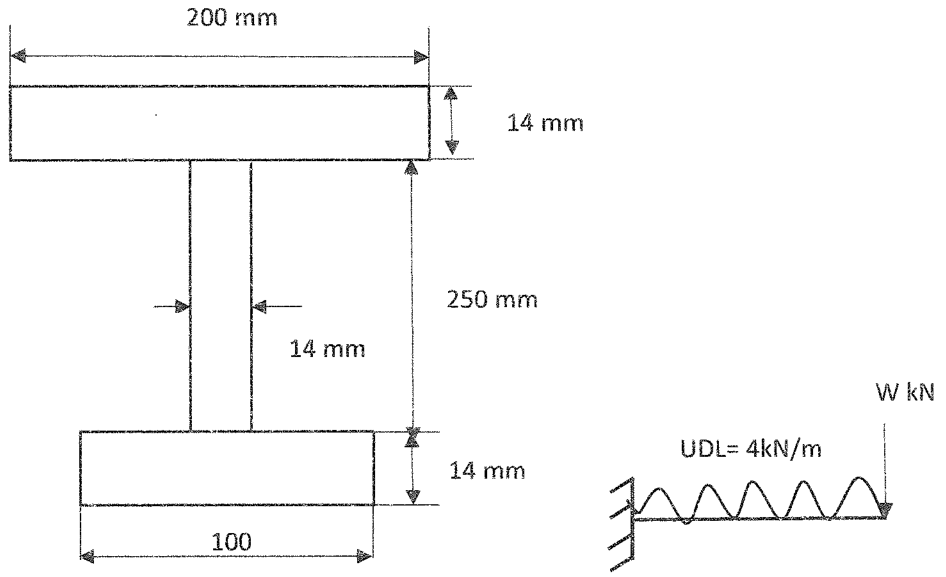


Figure 1

Part C [Problem Solving Questions]

Answer both the Questions. Each question carries eight marks. **(2Qx8M=16M)**

4. Define Section Modulus. Write the section Modulus equations with sketches for a i) Rectangle ii) Hollow Rectangle iii) Hollow circle iv) Triangle. (C.O.NO.2)[Knowledge]
5. A solid shaft transmits 250 kW at 100 rpm.If the shear stress is not to exceed 75 MPa what should be the diameter of the shaft? If this shaft is to be replaced by a hollow shaft, whose diameter ratio is 0.6, determine the size and percentage saving in weight, the maximum shear stress being the same. (C.O.NO.3)[Application]

SCHOOL OFENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: III

Course Code: MEC-206

Course Name: MECHANICS OF SOLIDS

Date: 19-11-2019

Time: 11.00 am to 12.00 pm

Max Marks: 40

Weightage: 20%

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			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1	CO-2	MODULE-2/ Stress & Strain	8									8
2	CO-3	MODULE-3 /Torsion	8									8
3	CO-3	MODULE-3 /Torsion				8						8
4	CO-2	MODULE-2/ Stress & Strain				8						8
5	CO-3	MODULE-3/ Torsion							8			8
	Total Marks		16			16			8			40

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. [Mr. D yeshwanth]

Reviewer's Comments:

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

Date:19-11-2019

Semester: ODD

Time: 11.00 am to 12.00 pm

Course Code: MEC-206

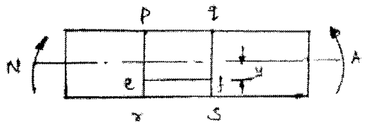
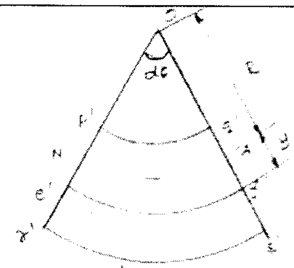
Max Marks: 40

Course Name: MECHANICS OF SOLIDS

Weight age: 20%

Part A (2Q x 8M =16 Marks)

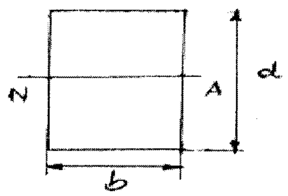
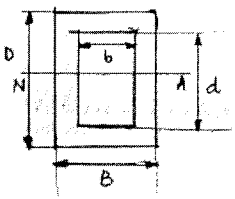
Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Assumptions in Simple Theory of Bending: 1. The material is homogneous & isotropic 2. Young's modulus is same > tension & Compression 3. Stresses are within elastic limit. 4. The beam is initially straight before bending. 5. Plane Section remains plane even after bending. 6. The radius of Curvature is large Compared to depth of beam	**Defintion-2M** **4 sketches-4M** **Z each-1/2 M-2M**	**15**

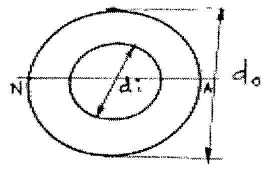
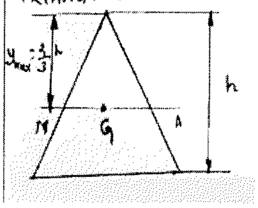
	 fig ⓐ  fig ⓑ $\epsilon = \frac{y}{R} \rightarrow (1)$ $\epsilon = \frac{\sigma_b}{E} \rightarrow (2)$ $\frac{\sigma_b}{E} = \frac{y}{R}$ $M = \frac{E}{R} I$ $\frac{M}{I} = \frac{E}{R}$ --(3) also $\frac{\sigma_b}{y} = \frac{E}{R}$ --(4) $\frac{M}{I} = \frac{\sigma_b}{y} = \frac{E}{R}$		
2	Torsion equation Derivation 1) The material is homogeneous & isotropic 2) The Stresses are within the elastic limit i.e, Shear Stress is Proportional to Shear Strain. 3) Cross-sections which are plane before applying twisting moment remain plane even after the application of twisting moment i.e, no warping takes place. 4) Radial lines remain radial even after applying torsional moment. 5) The twist along the Shaft is uniform.	**Derivation-4M** **Assumptions-4M**	**10**

Part B (1Q x 8M = 08 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
3	$\hat{Y} = 163mm$ I= 87.043 x 10^6 mm^4 M=[18+34] x 10^6 N-mm Stress due bending = 330/2 = 165MPa From bending eq: W=23.4 kN	$\hat{Y} - 1M$ I-1M Moment-1M Stress-1M W-1M	10

Part C (2Q x 8M = 16Marks)

<table>
<tr><th>Q No</th><th>Solution</th><th>Scheme of Marking</th><th>Max. Time required for each Question</th></tr>
<tr><td>4</td><td>Section Modulus: The ratio between moment of inertia of the transverse section of the beam about its neutral axis and the distance of extreme Fibre from the NA is known as Section Modulus.
<table>
<tr><th>Shape</th><th>Section Modulus</th></tr>
<tr><td>Rectangle:
</td><td>Z= $bd^2/6$</td></tr>
<tr><td>Hollow Rectangle
</td><td>$Z = \frac{BD^3 - bd^3}{6D}$</td></tr>
</table></td><td>Assumptions-2M
Sketch -2M
Strain-1M
Other equations -3M</td><td>15</td></tr>
</table>

	HOLLOW CIRCLE :  $Z = \frac{I}{y} = \frac{\pi}{32 d_o} [d_o^4 - d_i^4]$ TRIANGLE :  $Z = \frac{I}{y_{max}} = \frac{bh^2}{24}$		
5	P= 2πNT/60 T= 23.8732 X 10^6 N-mm T= J τ/R, d=117.473 mm, d_i=0.6 d_o, d_o= 123.036 mm d_i= 73.822 mm Area hollow shaft= 7609.164 mm^2 Area solid shaft = 10838.421 mm^2 % Saving = 29.725	Torque-1M Outer Dia= 1M Inner Dia =1M Areas=2M % Saving-1M	10

Roll No												

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20
Course Code: MEC 206
Course Name: MECHANICS OF SOLIDS
Program & Sem: B.Tech (MEC) & III

Date: 27 December 2019
Time: 1:00 PM to 4:00 PM
Max Marks: 80
Weightage: 40%

Instructions:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 1 mark. **(20Qx1M=20M)**

1. Fill in the blanks with appropriate answers. (C.O.No.1-4) [Knowledge]
   I. Hooke's law holds good up to............
   II. Young's modulus is defined as the ratio of stress to ....
   III. Deformation per unit length in the direction of force is known as............
   IV. The materials having same elastic properties in all directions are called................
   V. If a material expands freely due to heating the thermal stress developed in it is........
   VI. The ratio of lateral strain to the linear strain within elastic limit is known as...........
   VII. Principal planes are mutually inclined at...........
   VIII. In a general two dimensional stress system, planes of maximum shear stress are inclined at ___ with principal planes.
   IX. If depth of a beam is doubled then changes in its section modulus..............
   X. SI unit of shear force is......

2. Match the following (C.O.No.1-4) [Knowledge]

i.	Volumetric Strain	(a) ratio of normal force to instantaneous area of cross section
ii.	Point of contra flexure	(b) normal force per unit area
iii.	Ductility	(c) tangential force per unit area
iv.	Modulus of rigidity	(d) change in volume to original volume
v.	Normal stress	(e) ratio of shear stress and shear strain
vi.	Shear stress	(f) body returns to its original, shape after removal of the load
vii.	True stress	(g) materials can be drawn into wires
viii.	Elasticity	(h) materials can be beaten or rolled into plates
ix.	Malleability	(i) The total strain energy stored in a body
x.	Resilience	(j) bending moment is zero

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

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	A	
PART A 1	CO 01 CO 02 CO 03 CO 04	All the 4 modules	10 [2+2+3+3]	-	-	10
PART A 2	CO 01 CO 02 CO 03 CO 04	All the 4 modules	10 [2+2+3+3]	-	-	10
3	CO 02	Module 2 **Shear Stress and Deflection of Beams**	-	-	8	8
4	CO 03	Module 3 **Torsion and Bending**	-	8 -		8
5	CO 01	Module 1 **Stress and Strain**	-	8	-	8
6	CO 03	Module 3			8	8

Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Semester : Odd Semester: 2019 - 20

Course Code: MEC 206

Course Name: Mechanics of Solids

Program & Sem: B.Tech 3rd Sem

Date: 27 Dec 2019

Time: 3 Hours

Max Marks: 80

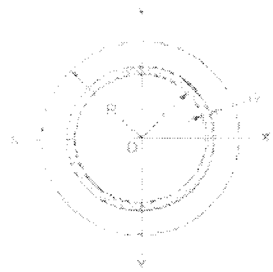
Weightage: 40 %

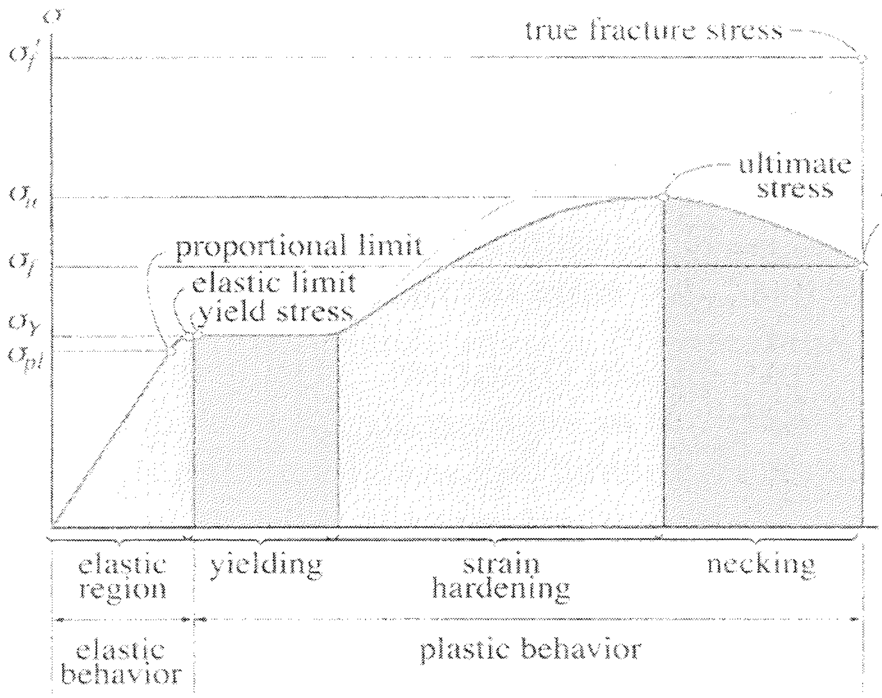
Part A (20Q x 1M = 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	I. Proportional limit II. Strain III. Linear strain IV. Isotropic V. Zero VI. Poission's ratio VII. 90 degree VIII. 45 degree IX. Will increase by 4 times X. Newton or KN	**1 mark each**	**15 min**
2	I. d) II. j) III. g) IV. e) V. b) VI. c) VII. a) VIII. f) IX. h) X. i)	**1 mark each**	**15 min**

Part B (4Q x 8M = 32Marks)

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

4	 *We have following information from above figure* R = Radius of the circular shaft D = Diameter of the circular shaft dr = Thickness of small elementary circular ring r = Radius of the small elementary of circular ring q = Shear stress at a radius r from the centre of the circular shaft τ = Shear stress at outer surface of shaft dA = Area of the small elementary of circular ring dA = 2Π x r x dr Shear stress, at a radius r from the centre, could be determined as mentioned here $q\ r = \tau\ R$ $q = \tau$ x r R Turning force due to shear stress at a radius r from the centre could be determined as mentioned here dF = q x dA dF = τ x r R x 2Π x r x dr dF = τ R x 2Π r^2dr Twisting moment at the circular elementary ring could be determined as mentioned here dT = Turning force x r dT = τ R x 2Π r^3dr dT = τ R x r^2 x (2Π x r x dr) dT = τ R x r^2 x dA	Assumptions 2 marks Diagram 2 marks Derivation 4 marks	20 MIN

<table>
<tr>
<td>5</td>
<td>


</td>
<td>4 marks</td>
<td>20 MIN</td>
</tr>
<tr>
<td></td>
<td>
1.Proportional Limit
It is the maximum stress up to which, the stress is linearly proportional to strain.
2. Elastic Limit
• Maximum stress a material can withstand without undergoing permanent deformation.
3. Yield Stress or Proof stress
It is the <s>stress at</s> which materials start to show permanent deformation.
4. Ultimate(Tensile or compressive) Strength or stress
Maximum stress that the material can withstand before failure (fracture) under tension or compression respectively.
</td>
<td>4 marks</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>
Assumptions in simple theory of bending:
1. The material is homogeneous & isotropic
2. Young's modulus is same in tension & Compression
3. Stresses are within elastic limit.
4. The beam is initially straight before bending.
5. Plane section remains plane even after bending.
6. The radius of Curvature is large Compared to depth of beam
</td>
<td>Definition -2M Expressions-2M Assumptions-4M</td>
<td>20 MIN</td>
</tr>
</table>

7

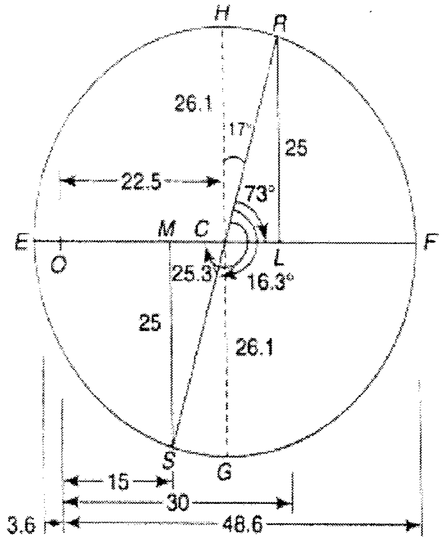


Fig. 2.20

In brief, $OL = 30$ MPa, $OM = 15$ MPa, $LR = MS = 25$ MPa. Mohr's circle is drawn with C, of LM as centre and passing through R and S.

- Major principal stress $= OF =$ 48.6 MPa (tensile) at angle $73/2 = 36.5°$ clockwise of C 30 MPa tensile stress.
- Minor principal stress $= OE =$ 3.6 MPa (compressive) at angle $253/2 = 126.5°$ clockw plane of 30 MPa tensile stress.

Maximum shear stress $= CG = CH = 26.1$ MPa

10 Marks

4 Marks

30 MIN

8 a)

Using the condition: $\Sigma M_A = 0$

$-R_B \times 8 + 8 \times 7 + 10 \times 4 + 5 \times 2 = 0 \rightarrow R_B = 13.25$ N

Using the condition: $\Sigma F_y = 0$

$R_A + 13.25 = 5 + 10 + 8 \rightarrow R_A = 9.75$ N

2 marks

Shear Force at the section 1-1 is denoted as V_{1-1}

Shear Force at the section 2-2 is denoted as V_{2-2} and so on...

$V_{0-0} = 0$; $V_{1-1} = +9.75$ N

$V_{2-2} = +9.75$ N

$V_{3-3} = +9.75 - 5 = 4.75$ N

$V_{4-4} = +4.75$ N

$V_{5-5} = +4.75 - 10 = -5.25$ N

$V_{6-6} = -5.25$ N

$V_{7-7} = 5.25 - 8 = -13.25$ N

$V_{8-8} = -13.25$

$V_{9-9} = -13.25 + 13.25 = 0$

2 marks

Bending moment at A is denoted as M_A

Bending moment at B is denoted as M_B

$M_A = 0$ [since it is simply supported]

$M_C = 9.75 \times 2 = 19.5$ Nm

$M_D = 9.75 \times 4 - 5 \times 2 = 29$ Nm

$M_E = 9.75 \times 7 - 5 \times 5 - 10 \times 3 = 13.25$ Nm

$M_B = 9.75 \times 8 - 5 \times 6 - 10 \times 4 - 8 \times 1 = 0$

or $M_B = 0$ [since it is simply supported]

30 MIN

Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20 **Date**: 27 December 2019

Course Code: PET 221 **Time**: 1:00 PM to 4:00 PM

Course Name: DRILLING FLUID AND CEMENTS **Max Marks**: 80

Program & Sem: B.Tech (PET) & III **Weightage**: 40%

Instructions:

(i) Read the all questions carefully and answer accordingly.
(ii) Scientific and Non-programmable calculators are permitted

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Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 1 marks. **(1Qx20M=20M)**

1. Give short answer to the following

i. The most commonly used cement is Class ___________.(Fill up the blanks)

(C.O.No.4) [Knowledge]

ii. The stability of Aphron based drilling fluid in HPHT environment is _________ (high/less). (Fill up the blanks) (C.O.No.1) [Knowledge]

iii. Starch is a mud __________________.(Fill up the blank) (C.O.No.2) [Knowledge]

iv. HEC stands for __________________. (Fill up the blank) (C.O.No.2) [Knowledge]

v. Lignosulphonate mud is stable up to temperature ______________degree F. (Fill up the blanks) (C.O.No.2) [Knowledge]

vi. What is the other name for Shear rate? (C.O.No.2) [Knowledge]

vii. Slope of Shear stress and Shear rate graph for a Bingham plastic fluid is called ________. (Fill up the blanks) (C.O.No.2) [Knowledge]

viii. Give two example of cement density inducing agents. (C.O.No.4) [Knowledge]

ix. What is shoe track? (C.O.No.4) [Knowledge]

x. Which central atom present in a tetrahedral lattice structure of a montmorilonite clay?

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

xi. What is the unit of YP? (C.O.No.1) [Knowledge]

xii. What is the other name for marsh funnel viscosity? (C.O.No.2) [Knowledge]

xiii. What is the commercial name for $2CaOAl_2O_3Fe_2O_3$? (C.O.No.4) [Knowledge]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q. N O.	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	A	
1	1, 2, 3 & 4	1, 2, 3 & 4	20			20
2	1, 2, 3 & 4	1, 2, 3 & 4		6		6
3	2, 3 & 4	2, 3 & 4		6		6
4	2	2		6		6
5	2	2		6		6
6	1	1		6		6
7	4	4			15	15
8	4	4			15	15
	Total Marks		20	30	30	80

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: Bhairab Ch. Gogoi

Reviewer Commend:

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

Q No	Solution	Scheme of Marking	Max. Time required for each Question
2	a. Reynolds number is more than 3000 means it is a turbulent flow. Whenever we cements a casing there must have a direct bond between Casing and the formation. As we know that while drilling a mud cake is formed against the permeable formation. So we need to remove the mud cake prior to a cementing job. A turbulent flow help us to remove the mud cake. b. When small size particles are kept together the void space left is less compared to larger size particles. So whenever we prepare drilling fluid with nano size clay particles so the mud cake thickness will be less and permeability also less so less amount of filtrate will escape into the formation. c. A hydro cyclone can't be used for weighted mud since it remove the barite. So we need to find an alternate. A mud cleaner to be used where the removed barite can be reuse. d. A spacer fluid separate Drilling fluid and Cement slurry. If Drilling fluid mixed with cement it will contaminate both. So with contamination the properties will degrade.	2+2+2	15
3	a. In highly porous and permeable formations we can add mud thickener or viscosifier to increase the viscosity of the mud which will prevent the fluid loss. Otherwise we can plug those loss circulation formation by injecting cements and then we can drill the next hole section. b. One of the major reason of Deep water horizon blowout is poor evaluation of the cementing job. If the leak of test was run properly they could have identify about the well integrity. c. If any space is left out behind casing while cementing then immediately we have to perform a squeeze cementing job and fill those gaps. d. In shale sensitive zone either we can use KCl/Polymer based drilling fluid or OBM as these zones are sensitive to water.	2+2+2	15
4	Aqueous (OBM) vs. Non aqueous (WBM) i. OBM has more environmental concern ii. OBM is preferred in HPHT well as it is thermally stable iii. OBM is preferred in a clay sensitive zone as it has less water content iv. OBM has less tendency to corrode downhole equipment v. OBM has more lubricity capacity vi. In OBM oil is continuous phase where WBM water is the continuous phase vii. WBM has better hole cleaning property viii. Fluid loss is more in OBM ix. Hole stability is better in case of WBM because better mud cake x. In offshore drilling WBM is preferred over OBM	6 points; 6 marks	15
5	Where possible, high temperature wells are drilled with oil-based fluids (OBFs) or synthetic-based fluids (SBFs), because of the thermal limitations of most water-based fluids (WBFs). Such limitations of WBFs include: Temperature-induced gelation High risk of CO2 contamination from the formation being drilled and/or from the degradation of organic mud additives Increased solids sensitivity that is related to high temperatures Historically, WBFs have relied on bentonite clay for both rheology and filtration control. When tested at temperatures ≥ 300°F under laboratory	6 points; 6 marks	15

Stage-cementing tools, or differential valve (DV) tools, are used to cement multiple sections behind the same casing string, or to cement a critical long section in multistages. Stage cementing may reduce mud contamination and lessens the possibility of high filtrate loss or formation breakdown caused by high hydrostatic pressures, which is often a cause for lost circulation.

Stage tools are installed at a specific point in the casing string as casing is being run into the hole. The first (or bottom) cement stage is pumped through the tool to the end of the casing and up the annulus to the calculated-fill volume (height). When this stage is completed, a shutoff or bypass plug can be dropped or pumped in the casing to seal the stage tool. A free-falling plug or pumpdown dart is then used to hydraulically set the stage tool and open the side ports, allowing the second cement stage (top stage) to be displaced above the tool. A closing plug is used to close the sliding sleeve over the side ports at the end of the second stage and serves as a check valve to keep the cement from U-tubing above and back through the tool.

Displacement stage cementing

The displacement stage-cementing method is used when the cement is to be placed in the entire annulus from the bottom of the casing up to or above the stage tool. The displacement method is often used in deep or deviated holes in which too much time is needed for a free-falling plug to reach the tool.

Fluid volumes (mud, spacer, cement) must be accurately calculated and prepared on locations and densities closely measured to prevent over- or underdisplacement of the first stage.

Overdisplacement can result in improper opening of the tool to apply the second (upper) stage, resulting in excess pressures or job failure. Underdisplacement creates a gap (void) in the cement column at the stage tool, which results in poor zonal isolation.

Two-stage cementing

Two-stage cementing is the most widely used multiple-stage cementing technique. However, when a cement slurry must be distributed over a long column and hole conditions will not allow circulation in one or two stages, a three-stage method can be used. The same steps are involved as in the two-stage methods, except that there is an additional stage. Obviously, the more stages used in the application, the more complicated the job will become. Although stage cementing was very popular many years ago, new foamed-cement and nonfoamed-ultralightweight-cement technologies have successfully reduced the need for multistage cementing in many operations.

Inner-string cementing

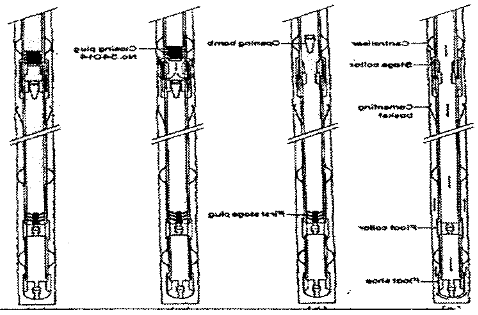
When large-diameter pipe is cemented, tubing or drillpipe is commonly used as an inner string to place the cement. This procedure reduces the cementing time and the volume of cement required to bump the plug. The technique uses modified float shoes, guide shoes, or baffle equipment, with sealing adaptors attached to small-diameter pipe. Cementing through the inner string permits the use of small-diameter cementing plugs. If the casing is equipped with a backpressure valve or latchdown baffle, the inner string can be disengaged and withdrawn from the casing as soon as the plug is seated, while preparations are made to drill deeper.

longest string is landed first. The first string is set in the hanger and is circulated before the second string is run. After the second string is landed in the hanger, it is circulated while the third string is run. In areas where lost circulation is a known problem, cement can be placed through the longest casing string. Once the cement fill-up has been established, the remainder of the hole is filled with cement slurry through a shorter string.

Centralizers are frequently used, one per joint from 100 ft above to 100 ft below productive zones. Other casing equipment in these small-diameter holes includes landing collars for cement wiper plugs, full-opening guide shoes, and limited-rotating scratchers for single completions. All float equipment, centralizers, and scratchers should be able to pass the hanger assembly in the casinghead.

Other factors considered in the design of cement slurry are similar to those considered in the design of slurry for a single string of pipe. The cement is usually pumped down the longest strings simultaneously, although this is not mandatory. The idle strings may be pressured to 1,000 to 2,000 psi during cementing to safeguard against:

Leakage
Thermal buckling
Collapse



may contain two pistons-cylinders (duplex pump) or three pistons-cylinders (triplex pump). Figure 9.06 shows schematics of a single piston-cylinder in (A) a single-action and (B) a double-action reciprocating pump.

In these pumps, the positive pressure and negative pressure (suction) in the cylinder cause the valves to open and close (note: the valves in the schematic are simple representations of the actual valves). Due to the high viscosity of the drilling fluid, the inlet side of the pump may require a Charge Pump to keep fluids moving into the cylinders at high pressures and to prevent Cavitation in the pump. From the mud pumps, the drilling fluid goes to the swivel, through the blow out preventer, and down the hollow drill string and bottom-hole assembly. The drilling fluid then goes through jet nozzles in the drill bit; at which point, it begins its return to the surface. The drilling fluid travels up the annular space between the drill pipe and the wellbore, picking up and carrying the drill cuttings up the hole.

Once the drilling fluid reaches the surface, it goes through the mud return line to the gas-mud separator and the solids control equipment. The shale shaker is where the large cuttings from the returning drilling fluid are removed. The shale shaker is a set of vibrating mesh screens that allow the mud to pass through while filtering out cuttings of different size at screen screen mesh sizes. A Mudlogger or a Well-Site Geologist may be stationed at the shale shaker to analyze the cuttings to determine the lithology of the rock and the depth within the Stratigraphic Column at which the well is currently being drilled.

The drilling fluid then passes through the Desander and Desilter. These are hydrocyclones which use centrifugal forces to separate the smaller solids from the drilling fluid. The desander typically removes solids with a diameter in the range of 45 – 74 μm, while the desilter removes solids with a diameter in the range of 15 – 44 μm.

The drilling fluid is then sent through a degasser to remove any gas bubbles that have been picked up during the circulation. These gasses may include natural gas from the subsurface or air acquired during the solids control. Typically, the degasser is a piece of equipment that subjects the drilling fluid to slight vacuum to cause the gas to expand for extraction. The drilling fluid is then returned to the mud pit to start the circulation process over again.

We have discussed the mechanics of how the drilling fluid is circulated during the drilling process, but we have not discussed the role of the drilling fluid. The term "mud" is often used in oil and gas well drilling because historically the most common water-based drilling fluids were mixtures of water and finely ground, bentonite clays which, in fact, are muds.

There are many objectives for using a drilling fluid. These include:

lift drill cuttings from the bottom of the wellbore to the surface;
suspend cuttings to prevent them from falling downhole if circulation is temporarily ceased;
release the cuttings when they are brought to the surface;
stabilize the borehole during drilling operations (exert hydrostatic or hydrodynamic pressure on the borehole to prevent rock caving into the wellbore);

	drag between the drill pipe and the wellbore is reduced with oil-based muds; achieving greater thermal stability at greater depths. Oil-based muds have been found to retain their stability (retain their desired properties) at greater down hole temperatures; achieving greater resistance to chemical contamination. Many substances found down-hole (salt, CO2, H2S, etc.) are soluble in water. The introduction of these substances into the water-based mud system may have a deleterious impact on different mud properties (density, viscosity, fluid loss properties, gelling properties, etc.). These substances are not soluble in oil and, therefore, have will not impact oil-based mud properties. The first three bullet points in this list are becoming more common problems in the oil and gas industry. The shale boom in the U.S. has made long horizontal sections in shale reservoirs targets for drilling. In addition, deviated wells and deeper wells are also becoming more common. For these reasons, the use of oil-based muds is also becoming more common. There are also several disadvantages with oil-based muds. These include: high initial costs. Often in an active drilling campaign, if certain depth intervals require an oil-based mud, the mud is stored and reused in different wells; slow rates of penetration. Historically, the rate of penetration has been statistically slower for oil-based muds than it is for water-based muds. The rate of penetration is the speed at which the drilling process progresses (depth versus time) and is a function of many factors other than mud type, including: weight on bit, RPM, lithologies being drilled through, bit type, bit wear, etc.; environmental concerns: oil contamination of subsurface fresh water aquifers, cleaning and disposal of oil contaminated rock cuttings; kick detection. If gas enters the wellbore (a Kick), it may go into solution in the oil in deeper, higher pressure sections of the well and come out of solution closer to the surface; formation evaluation. Some readings from well logs or core analysis may be sensitive to oil entering the formation of interest (for example, if oil from the oil-based mud enters the reservoir in the near-well vicinity, then tools used to detect oil saturation may read artificially high). Other drilling fluids currently in use that were listed earlier are foams and air. In the context of drilling fluids, foams have the consistency of shaving cream. Both foam and air drilling are used in hard rock regions, such as in the Rocky Mountains, where drill bits render the drill cuttings to dust. Thus, the foam or air only needs to lift this dust to the surface. Air drilling is always an environmentally friendly option if it is applicable because environmental contamination by air is never an issue.		
8	a. Weight of the cement: 94 lb Volume of cement: 94/26.18=3.59 gal Weight of water: 42.4 lb Volume of water: 42.3/8.33=5.08 gal Density of the cements slurry is: (94+42.3)/(3.59+5.08)=15.72 ppg	a. 5 marks b. 1.5+1.5 c. 2+1.5+1.5+2	

Part C [Problem Solving Questions]

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

7. Explain multistage cementing with suitable diagrams. (C.O.No.4) [Application]

OR

Draw a flow chat of the entire mud circulatory system (both surface and subsurface. Write the operational procedure and function of each component. (C.O.No.3) [Application]

8. Solve the following problems

a. The cement slurry was blended using the following data: i) one sack of class G cement, and ii) 45% fresh water. Determine the slurry density. (Density of Cement is 26.18 ppg)
b. A rotational viscometer containing cement slurry gives a dial reading of 176 at a rotor speed of 300 RPM and a dial reading of 236 at a rotor speed of 600 RPM. Calculate plastic viscosity and yield point.
c.

Estimate the slurry volume used to cement the 500 feet cement column in the casing schematic below.

Given,

- Production casing, 9 5/8" OD and 8.681" ID (61 lb/ft)
- Intermediate casing, 13 3/8" OD and 12.347" (54.5 lb/ft)

If hole size is 20" and the target depth is 800 feet then what will the total volume of cement required to fill the entire annulus outside Production casing? How many sacks of cement were used if slurry yield was 1.12 ft3/sack?
If the pumping rate is 200 gpm then what will be total time required to cement the annulus between Intermediate and Production casing.

(C.O.No.4) [Application]