MANIPAL INSTITUTE OF TECHNOLOGY,
(A Constituent Institute of MANIPAL UNIVERSITY)
Department of Civil Engineering

MANIPAL - 576 104, Karnataka, India.

**Subject (Name & Code): Mechanics of Solids (CIE 1001)**
**Date of the Examination: 28-03-2016**

## SESSIONAL- II

Note: 1. all questions are compulsory 2. Determine centroid and second moment of area only with respect to reference axes shown in the figure.

**MULTIPLE CHOICE QUESTIONS** **(1x5=5m)**

**a) First moment of total area about its centroidal axis is**

*Zero *three times the area *two times the area *non zero

**b) The second moment of area of a triangle of base b and height h about the base will be**

*$bh^3/36$ *$bh^3/12$ *$hb^3/36$ *$hb^3/12$

**c) The true breaking stress of a ductile material from a tension test will be:**

*greater than ultimate strength *equal to ultimate strength *equal to nominal breaking stress

*less than the ultimate strength but greater than nominal breaking stress

**d) For a certain material Poisson's ratio is 0.25. Then the ratio of modulus of elasticity to the modulus of rigidity for the material is:**

* 0.4 * 2.5 * 4 * 0.5

**e) Identify the correct relationship between the modulus of elasticity E, modulus of rigidity G and bulk modulus K**

$*E = \frac{(3K+G)}{9KG}$ $*E = \frac{3KG}{(3K+G)}$ $*E = \frac{9KG}{(3K+G)}$ $*E = \frac{9KG}{(3G+K)}$

**1.** Determine the spacing 'd' shown in **Fig. Q1** such that $I_{xx} = I_{yy}$ for the shaded area. **(2m)**

**2.** Determine the centroidal coordinates with respect to reference axes shown in **Fig. Q2**. **(3m)**

**3.** A circular bar of length 200 mm and 30 mm diameter is subjected to an axial pull of 60kN. The measured extension in length is 0.1 mm and change in diameter is 0.004 mm. Calculate (i) Bulk modulus (ii) Volumetric strain and (iii) Poisson's ratio. **(2m)**

**4.** A composite bar made of steel and copper is 4 m long. The steel bar has uniform diameter of 25mm for 2m length and the copper bar increases in diameter from 25 to 50 mm for the next 2 m length. If axial loads applied are as shown in the **Fig. Q4**, determine the magnitude of P and calculate (i) Stress in steel bar (ii) Stress at section X-X for the copper bar. Given $E_s = 200GPa$ $E_{cu} = 100$ GPa. **(3m)**

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## Department of Civil Engineering

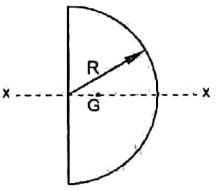
**Subject (Name & Code): Mechanics of Solids (CIE 1001)**

**Date of Examination: 05/11/2016**

## Sessional Test- II

**Note: (i) All questions are compulsory** **Total Marks: 15**

**(ii)Write the appropriate full answer for multiple choice questions.**

| Q. No | Questions | Marks | CO |
|---|---|---|---|
| 1A | A circular hole is to be punched out of a plate by applying a compressive force of 200 kN. If the thickness of plate and diameter of hole are 20 mm and 100 mm respectively, then the average shear stress in the plate is,<br>• 47.75 N/mm$^2$<br>• 31.83 N/mm$^2$<br>• 25.465 N/mm$^2$<br>• 12.73 N/mm$^2$ | 01 | CO3 |
| 1B | Two tapering bars of same material is subjected to a tensile load P. The lengths of both the bars are same. The larger diameter of each of the bars is D. The diameter of the bar A at its smaller end is $\frac{D}{2}$ and that of the bar B is $\frac{D}{3}$. What is the ratio of elongation of the bar A to that of bar B?<br>• 3:2<br>• 2:3<br>• 4:9<br>• 1:3 | 01 | CO3 |
| 1C | Second moment of area of a semicircle of radius 'R' (**Fig.Q1C**) about horizontal centroidal axis is,<br>• $\frac{\pi R^4}{4}$<br>• $\frac{\pi R^4}{8}$<br>• $0.11R^4$<br>• $0.055R^4$<br>  <br>Fig.Q1C | 01 | CO2 |
| 1D | The moduli of elasticity and rigidity of a material are 195 GPa and 75 GPa respectively. The value of the Poisson's ratio of the material is,<br>• 0.3<br>• 0.26<br>• 0.25<br>• 0.24 | 01 | CO3 |
| 1E | A steel rod of diameter 2 cm and 1.5 m long is heated from 25°C to 125°C. Its $\alpha = 12 \times 10^{-6}$/°C and E = 200 GN/m$^2$. If the rod is free to expand, the temperature stress developed is,<br>• 120 N/mm$^2$<br>• 240 N/mm$^2$<br>• Zero<br>• Infinity | 01 | CO3 |

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## Department of Civil Engineering

MANIPAL - 576 104, Karnataka, India.

**Subject: Mechanics of Solids (CIE 1001)**

**Date of Examination: 18-03-2017** **Sessional Test- II**

**Total Marks: 15**

**Note: (i) All questions are compulsory**

**(ii)Write the appropriate full answer for multiple choice questions.**

| Q. No | Questions | Marks | CO |
|---|---|---|---|
| 1A | The moment of inertia of a triangle of base 'b' and height 'h' about the base will be ___<br>• $bh^3/36$<br>• $bh^3/12$<br>• $bh^3/6$<br>• $bh^3/3$ | 01 | CO2 |
| 1B | The value of poison's ratio depends upon _____<br>• Nature of load (tensile or compressive)<br>• Magnitude of load<br>• Material of the test specimen<br>• Dimensions of the test specimen | 01 | CO3 |
| 1C | When a wire is stretched to double in length, the longitudinal strain produced in it is__<br>• 0.5<br>• 1.0<br>• 1.5<br>• 2.0 | 01 | CO3 |
| 1D | Percentage elongation during tensile test is indication of _____<br>• Ductility<br>• Malleability<br>• Creep<br>• Rigidity | 01 | CO3 |
| 1E | For a material if bulk modulus = 330GPa and Poisson's ratio =0.4, then modulus of elasticity is_____<br>• 132GPa<br>• 1782GPa<br>• 198GPa<br>• 1188GPa | 01 | CO3 |

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(A Constituent Institute of MANIPAL UNIVERSITY)

## Department of Civil Engineering

MANIPAL - 576 104, Karnataka, India.

**Subject: Mechanics of Solids (CIE 1001)**

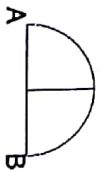
**Date of Examination: 30 -03 -2017** RE-TEST

**Sessional Test- II (. )**

**Total Marks: 15marks**

**Note: (i) All questions are compulsory**

**(ii)Write the appropriate full answer for multiple choice questions.**

| Q. No | Questions | Marks | CO |
|---|---|---|---|
| 1A | The moment of inertia of given semi-circle of radius "R" with respect to horizontal centroidal axis _____   • $0.11R^4$ • $0.055R^4$ • $\pi R^4/16$ • $\pi R^4/8$ | 01 | CO2 |
| 1B | The percentage elongation and the percentage reduction in area depends upon _____ • Tensile strength of the material • Ductility of the material • Toughness of the material • None of these | 01 | CO3 |
| 1C | A rigid body has poison's ratio equal to _____ • 0 • 1 • Less than 1 • Greater than 1 | 01 | CO3 |
| 1D | The relation between modulus of elasticity ( E ) , modulus of rigidity (G) and bulk modulus (K) is given as _____ • $\frac{9GK}{3K+G}$ • $\frac{3GK}{9K+G}$ • $\frac{9GK}{K+3G}$ • $\frac{GK}{3K+4G}$ | 01 | CO3 |
| 1E | Time dependent yield is known as _____ • Fracture • Fatigue • Buckling • Creep | 01 | CO3 |

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## I SEMESTER B.TECH. INTERNAL EXAMINATIONS OCTOBER 2017

## TEST - 2

## SUBJECT: MECHANICS OF SOLIDS [CIE 1001]

Date of Exam: **16/10/2017** Time of Exam: **8.00 AM - 9.00 AM** Max. Marks: **15**

**Instructions to Candidates:**

- Answer ALL the questions & missing data may be suitably assumed
- Write complete answers for Q.1

| | | |
|---|---|---|
| **1.** | Choose the appropriate answer for following multiple choice questions. | |
| | a) If 'I' is the moment of inertia, 'A' is area of the geometry and 'K' is radius of gyration then,<br>○ $I = KA^2$ ○ $I = K^2A$ ○ $I = \sqrt{\frac{K}{A}}$ ○ $I = \sqrt{\frac{A}{K}}$ | 1 |
| | b) Depth of a tapered bar of rectangular cross section with uniform thickness 'b' varies from $d_1$ to $d_2$ ($d_2 > d_1$) for a length 'L', is subjected to an axial load of 'P'. If elastic modulus of the bar is E, $d_1 = d_2/2$ and $L = 2d_2$ then total deformation is,<br>○ $\frac{1.20\,P}{b\,E}$ ○ $\frac{0.693\,P}{b\,E}$ ○ $\frac{0.301\,P}{b\,E}$ ○ $\frac{2.77\,P}{b\,E}$ | 1 |
| | c) The relationship between Young's modulus 'E' and bulk modulus 'K' is given by,<br>○ $E = 2K(1 - 2\mu)$ ○ $E = 2K(1 - \mu)$ ○ $E = 3K(1 - 2\mu)$ ○ $E = 3K(2 - \mu)$ | 1 |
| | d) A rod of diameter 'd' is embedded in a concrete block to a length 'L'. If an axial load 'P' is applied to the rod, the shear stress developed is,<br>○ $\frac{P}{\pi d L}$ ○ $\frac{4P}{\pi d^2 L}$ ○ $\frac{2P}{\pi d L}$ ○ $\frac{2P}{\pi d^2 L}$ | 1 |
| | e) Moment of inertia of a quarter circle of radius 'r' about an axis passing through its base is,<br>○ $0.392\,r^4$ ○ $0.196\,r^4$ ○ $0.251\,r^4$ ○ $0.785\,r^4$ | 1 |
| **2.** | A bar is subjected to forces as shown in **Fig.1**. Determine the change in dimension in each direction and also the change in volume of the bar. Consider E = 210 GPa, $\mu$ = 0.3 | 3 |
| **3.** | Determine the moment of inertia of the shaded portion of geometrical area given in **Fig. 2** with respect to the reference axis **AB**. | 3 |
| **4.** | An aluminium bar is attached to a steel circular tapered rod and a copper bar as shown in **Fig.3**. Determine the total change in length of bar. $E_{st}$ = 200 GPa; $E_{al}$ = 70 GPa; $E_{cu}$ = 110 GPa. | 2 |
| **5.** | For a square element, prove that in a state of simple shear, magnitude of direct stress along diagonal is equal to magnitude of shear stress. | 2 |

# MANIPAL INSTITUTE OF TECHNOLOGY

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II SEMESTER B.TECH. INTERNAL EXAMINATIONS MARCH 2018

## TEST - 2

## SUBJECT: MECHANICS OF SOLIDS [CIE 1001]

Date of Exam: **19/03/2018** Time of Exam: **1.45 PM - 2.45 PM** Max. Marks: **15**

**Instructions to Candidates:**

- Answer ALL the questions & missing data may be suitably assumed
- Write complete answers for Q.1

| | | |
|---|---|---|
| **1.** | Choose the appropriate answer for following multiple choice questions. | |
| | a) The radius of gyration of a circular area of radius 'r' about its vertical centroidal axis is,<br>• $r/2$ • $r/4$ • $3r/2$ • $3r/4$ | **1** |
| | b) The first moment of a semicircular area about its diameter 'd' is given by,<br>• $d^3/12$ • $d^3/24$ • $d^3/6$ • $d^3/36$ | **1** |
| | c) Hooke's law is applicable up to,<br>• yield point • elastic limit • breaking point • proportionality limit | **1** |
| | d) The percentage reduction in area of a member subjected to tension test is indicative of its _____ property.<br>• ductility • elasticity • malleability • brittleness | **1** |
| | e) If the Poisson's ratio of a material is 0.25, the ratio of modulus of rigidity to modulus of elasticity is,<br>• 2 • 0.4 • 2.5 • 1.5 | **1** |
| **2.** | Locate the centroid of hatched portion in the lamina shown in **Fig.1** with respect to Y-Y axis. | **2** |
| **3.** | Determine the second moment of area of hatched portion in the lamina shown in **Fig. 2** with respect to its vertical centroidal axis. | **3** |
| **4.** | Define the following terms: a) Shear stress b) Modulus of rigidity | **2** |
| **5.** | A composite bar consists of bronze, aluminum and steel sections of diameter 20 mm as shown in **Fig. 3**. Axial loads are applied at the positions indicated. Determine the stress developed in each section. Also, determine the change in total length of the composite bar. Consider $E_b$ = 100 GPa, $E_a$ = 70 GPa, $E_s$ = 210 GPa. | **3** |

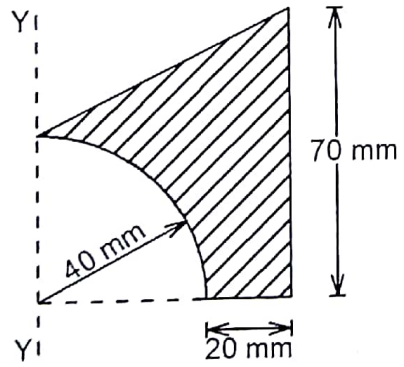


**Fig. 1 (Q. 2)**

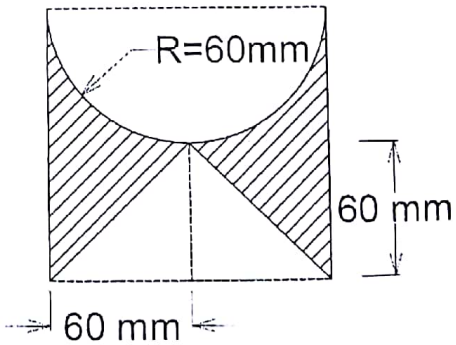


**Fig. 2 (Q. 3)**

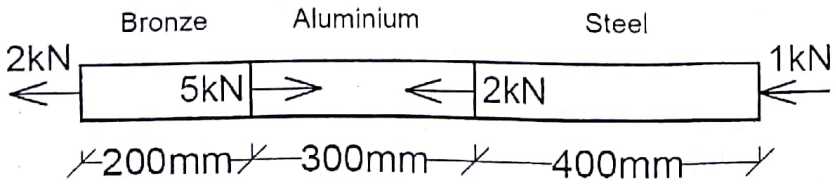


**Fig. 3 (Q. 5)**

# MANIPAL INSTITUTE OF TECHNOLOGY
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**Subject (Name & Code): Mechanics of Solids (CIE 1051)**

**Date of Examination: 10/04/2019**

## Sessional II (Makeup)

**Total Marks: 15**

| Q. No | Questions | Marks | CO |
|---|---|---|---|
| 1a | The second moment of area of a semicircle of radius 'r' about an axis passing through its base diameter is:<br>• $0.11r^4$ • $0.055r^4$ • $\pi r^4/8$ • $0.393\ r^4$ | 0.5 | 3 |
| 1b | The radius of gyration for a triangular area with base width 10 mm and height 20 mm about its base is<br>• 6.67 mm • 18.25 mm • 8.16 mm • 4.71 mm | 0.5 | 3 |
| 1c | Moment of inertia about an axis perpendicular to the plane of area is ------<br>• polar moment of inertia • second moment of inertia<br>• radius of gyration • first moment of area | 0.5 | 3 |
| 1d | The moment of inertia of a triangular section of base 'b' and height 'h' about an axis passing through its base is ..... times the moment of inertia about an axis passing through its C.G. and parallel to the base<br>• 9 • 4 • 2 • 3 | 0.5 | 3 |
| 1e | Within the limit of proportionality, shear modulus is the ratio of<br>• linear stress to linear strain • linear stress to lateral strain<br>• hydrostatic stress to volumetric strain • shear stress to shear strain | 0.5 | 4 |
| 1f | Identify the correct relationship between the modulus of elasticity E, modulus of rigidity G and bulk modulus K<br>• $\frac{3K+G}{9KG}$ • $\frac{3KG}{3K+G}$ • $\frac{9KG}{3K+G}$ • $\frac{9KG}{3G+K}$ | 0.5 | 4 |
| 1g | Factor of safety for a ductile material is the ratio of<br>• Ultimate stress to yield stress • Ultimate stress to working stress<br>• Breaking stress to working stress • Yield stress to working stress | 0.5 | 4 |
| 1h | Under tensile test, a test specimen of a material is having 40% elongation whereas another test specimen of the same dimensions but of different material is having 25% elongation. Then the ductility of the first material as compared to that of second material is<br>• less • same • more • none of the above | 0.5 | 4 |
| 1i | The modulus of elasticity and Poisson's ratio of a material are $12.5x10^3$MPa and 0.34 respectively. The modulus of rigidity of the material is<br>• 33.50 MPa • 33.50 GPa • 4.66 GPa • 4.66 MPa | 0.5 | 4 |
| 1j | A spherical ball of volume $10^6$ mm$^3$ is subjected to a hydrostatic pressure of 90 N/mm$^2$. If the bulk modulus for the material is 180 kN/mm$^2$. The change in the volume of the ball will be<br>• 50 mm$^3$ • 250 mm$^3$ • 100 mm$^3$ • 500 mm$^3$ | 0.5 | 4 |

# MANIPAL INSTITUTE OF TECHNOLOGY

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**Subject (Name & Code): Mechanics of Solids (CIE 1051)**

**Date of Examination: 01/04/2019**

## Sessional II(Re-registered)

**Total Marks: 15**

| Q. No | Questions | Marks | CO |
|---|---|---|---|
| 1a | The value of second moment of area of a lamina about its centroidal axis is:<br>• Zero • Always positive • Always negative • Same as the centroid | 0.5 | 3 |
| 1b | The radius of gyration for a rectangle of width 10 mm and depth 20 mm about the base is<br>• 3.33 mm • 10 mm • 11.55 mm • 5.77 mm | 0.5 | 3 |
| 1c | The moment of inertia of a lamina of area A with respect to the X axis is defined as<br>• $\int dA\, y^2$ • $\int dA\, x^2$ • $\int dA\, x$ • $\int dA\, y$ | 0.5 | 3 |
| 1d | Polar moment of inertia of a plane area is<br>• $I_{xx} * I_{yy}$ • $I_{xx} + I_{yy}$ • $I_{xx}/I_{yy}$ • $\sqrt{\frac{Izz}{A}}$ | 0.5 | 3 |
| 1e | Tensile test was conducted on a steel bar. An extension of 2mm was observed at failure over a gauge length of 10cm. What will be the percentage elongation?<br>• 0.002 • 0.02 • 0.2 • 2 | 0.5 | 4 |
| 1f | The Poisson's ratio is defined as<br>• axial stress/lateral stress • lateral strain/axial strain<br>• lateral stress/axial stress • axial strain/lateral strain | 0.5 | 4 |
| 1g | The ductility of a material _____ with increase in percentage reduction in area of a specimen under tensile test.<br>• Increases • Decreases • Remains same • None of these | 0.5 | 4 |
| 1h | Every material obeys the Hooke's law within<br>• Elastic limit • Plastic limit • Limit of proportionality • Yield point | 0.5 | 4 |
| 1i | A circular hole is to be punched out of a plate by applying a compressive force of 200 kN. If the thickness of plate and diameter of hole are 20 mm and 100 mm respectively, then the average shear stress in the plate is,<br>• 47.75 MPa • 31.83 MPa • 25.465 MPa • 12.73 MPa | 0.5 | 4 |
| 1j | A single compressive stress ($\sigma$) is acting along the width, then the strain in the lateral direction will be<br>• $\mu\sigma/E$ • $-\sigma/E$ • $-\mu\sigma/E$ • None of the above | 0.5 | 4 |

# MANIPAL INSTITUTE OF TECHNOLOGY

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**Subject (Name & Code): Mechanics of Solids (CIE 1051)**

**Date of Examination: 25/03/2019**

## Sessional II

**Total Marks: 15**

| Q. No | Questions | Marks | CO |
|---|---|---|---|
| 1a | Moment of inertia of a equilateral triangle of side 'b' about its base is ____<br>• $\frac{b^3}{12}$ • $\frac{b^4}{36}$ • $\frac{\sqrt{2}b^3}{\beta 2}$ • $\frac{\sqrt{3}b^4}{32}$ | 0.5 | 3 |
| 1b | The polar moment of inertia of a circular section of diameter D, about its centroidal axis is<br>• $\pi D^4/64$ • $\pi D^3/32$ • $\pi D^4/32$ • $\pi D^3/16$ | 0.5 | 3 |
| 1c | If a lamina of an area 125 $mm^2$ has a radius of gyration of 3 mm about an axis, then the second moment of area of that lamina about same axis is equal to<br>• 216.5 $mm^4$ • 1125 $mm^4$ • 1125 mm • 100.62 $mm^4$ | 0.5 | 3 |
| 1d | If $I_G$ is moment of inertia of a rectangle about its centroidal axis and $I_{AB}$ is moment of inertia of same rectangle about its base, then<br>• $I_G > I_{AB}$ • $I_G < I_{AB}$ • $I_G = I_{AB}$ • $I_G \geq I_{AB}$ | 0.5 | 3 |
| 1e | In engineering stress-strain curve for mild steel, the ultimate tensile strength refers to<br>•Yield stress •Proportionality limit •Fracture stress •None of the above | 0.5 | 4 |
| 1f | Elongation of a steel rod of 100mm length when it is subjected to a tensile strain of 0.005 is<br>• 0.2mm •0.3mm • 0.5mm • 0.1mm | 0.5 | 4 |
| 1g | The percentage elongation and the percentage reduction in area is a measure of<br>• Elasticity of the material • Ductility of the material<br>• Toughness of the material • Hardness of the material | 0.5 | 4 |
| 1h | A bar of diameter 'd' is embedded in a concrete block to a length 'L'. If an axial load 'P' is applied to the bar, the average shear stress developed is,<br>• $\frac{p}{\pi dL}$ • $\frac{4p}{\pi d^2 L}$ • $\frac{2p}{\pi dL}$ • $\frac{2p}{\pi d^2 L}$ | 0.5 | 4 |
| 1i | When a wire is stretched to double in length, the longitudinal strain produced in it is<br>• 0.5 • 1.0 • 1.5 • 2.0 | 0.5 | 4 |
| 1j | A material has Poisson's ratio of 0.5. If uniform pressure of 300GPa is applied to this material, what will be the volumetric strain?<br>•0.50 • 0.20 • 0.25 • 0 | 0.5 | 4 |