Code No: R1621032 **R16** SET - 1

II B. Tech I Semester Supplementary Examinations, May - 2018
MECHANICS OF SOLIDS
(Com to ME, AE & AME)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) Draw the Stress- Strain diagram for Cast Iron and mention the Salient points? (2M)

   b) What are the effects of inclined load on the Beam? (2M)

   c) What is the section modulus and how it will affect the strength of the beam? (2M)

   d) State the Mohr's theorem I & II to determine the Deflection of the beam? (3M)

   e) A vessel in the shape of spherical shell of 1.20 m internal diameter and 12 mm shell thickness is subjected to pressure of 1.6 N/mm^2. Determine the stresses induced in the material of shell? (3M)

   f) Define the torsional rigidity of the shaft? What does it represent? (2M)

PART -B

2. a) A weight of 10 KN falls by 30 mm on a collar rigidly attached to a vertical bar 4 m long and 1000 mm^2 in section. Find the instantaneous expansion of bar. Take E= 210 Gpa. (7M)

   b) An elemental cube is subjected to tensile stresses of 30 N/mm^2 and 10 30 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 30 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence or otherwise determine the magnitudes and directions of principal stresses and also greatest shear stress. (7M)

3. A simple supported beam of length 8m rests on supports 6m apart, the right hand end is overhanging by 2 m. The beam carries a uniformly distributed load of 1500 N/m over the entire length. Draw the shear force and bending moment diagrams and find the point of contra flexure, if any? (14M)

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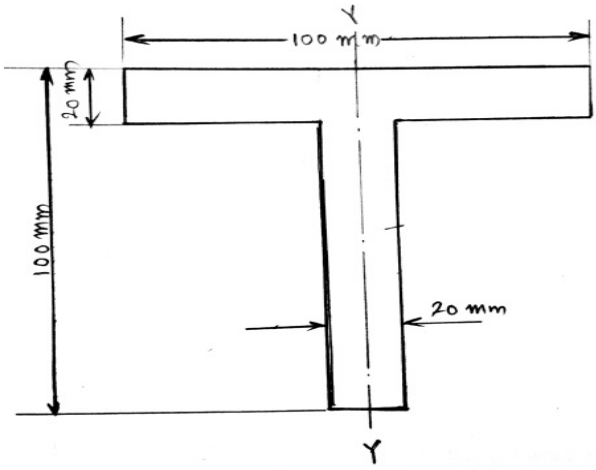
4. The Shear force acting on a section of a beam is 50 KN. The section of the beam is T shaped of dimensions 100 mm x 100 mm x 20 mm as shown in the fig. The moment of inertia about the horizontal neutral axis is 314.221 x 10^4 mm^4. Calculate the shear stress at the neutral axis and at the junction of the web and flange? (14M)



5. A cantilever of length 2m carries a point load of 20 kN at the free end and another load of 20 kN at its center. If E = 10^5 N/mm^2 and I=10^8 mm^4 for the cantilever then determine by moment area method, the slope and deflection of the cantilever at the free end. (14M)

6. Determine the maximum and minimum hoop stress across the section of a pipe of 400 mm internal diameter and 100 mm thick, when the pipe contains a fluid at a pressure of 8 N/mm^2. Also sketch the radial pressure distribution and hoop stress distribution across the section? (14M)

7. a) A simply supported beam of length 4m is subjected to a uniformly distributed load of 30 kN/m over the whole span and deflects 15 mm at the center. Determine the crippling load when the beam is used as column with both the ends pin jointed? (7M)

   b) Derive the relation for a circular shaft when subjected to torsion as $T/J = \tau/R = G\Theta/L$ (7M)

   Where T is torque transmitted, J = polar moment of inertia, τ = Max. Shear stress, R = radius of shaft, G= modulus of rigidity, Θ = angle of twist, L= length of shaft.

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Code No: R1621032 **R16** SET - 1

II B. Tech I Semester Supplementary Examinations, October/November - 2020
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Time: 3 hours Max. Marks: 70

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PART –A

1. a) Two parallel walls 6m apart are stayed together by a steel rod 25 mm diameter passing through metal plates and nuts at each end. The nuts are tightened home, when the rod is at a temperature of 100^0C. Determine the stress in the rod, when the temperature falls down to 60^0C and the ends yield by 1 mm? (3M)

   b) Describe the effect of couple on the S.F and B.M diagram of a beam? (2M)

   c) State the assumptions made in the 'theory of simple bending'? (2M)

   d) How to calculate the deflection by the 'moment area method'? (2M)

   e) A solid steel shaft is to transmit a torque of 10 KN-m. if the shearing stress is not to exceed 45 MPa, find the minimum diameter of the shaft? (3M)

   f) Write Expression for Euler's crippling load for column when it has both ends hinged and both ends fixed? (2M)

PART -B

2. a) An element in a strained body is subjected to a compressive stress of 200 MPa and a clockwise shear stress of 50 MPa on the same plane. Calculate the values of normal and shear stresses on a plane inclined at 35^0 with the compressive stress. Also calculate the value of maximum shear stress in the element. (7M)

   b) An axial pull of 20 KN is suddenly applied on a steel rod of 2.5 m long and 1000 mm^2 in cross-section. Calculate the strain energy, which can be absorbed in the rod. Take the E= 200 GPa? (7M)

3. A simply supported beam AB, 6 m long is loaded as shown in fig.3.1. (14M)

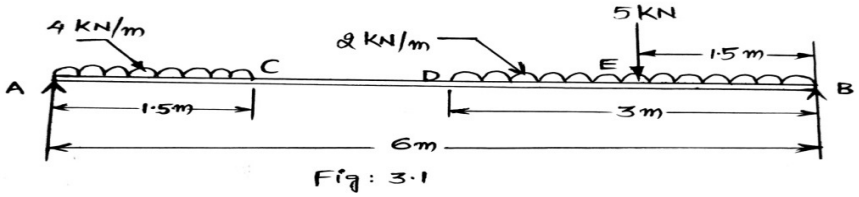

Fig : 3.1

Construct the shear force and bending moment diagrams for the beam, find the position and value of maximum bending moment?

4. a) Two beams are simply supported over the same span and have the same flexural strength. Compare the weights of these two beams, if one of them is solid and the other is hollow circular with internal diameter half of the external diameter? (7M)

   b) Derive an expression for the shear stress at any point in the cross-section of a beam? (7M)

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5. A timber beam of rectangular section has a span of 4.8 meters and is simply supported at its ends. It is required to carry a total load of 45 KN uniformly distributed over the whole span. Find the values of breadth (b) and depth (d) of the beam, if the maximum bending stress is not to exceed 7 MPa and maximum deflection is limited to 9.5 mm. Take E for timber as 10.5 GPa. (14M)

6. a) A cylindrical thin drum 80 cm in diameter and 3 m long has a shell thickness of 1 cm. If the drum is subjected to an internal pressure of 2.5 N/mm^2, determine the i) change in diameter ii) change in length iii) change in volume? (7M)

   b) The hoop stress is Minimum at the outer surface and is Maximum at the inner surface of a thick cylinder, prove the statement. Sketch the radial pressure distribution and hoop stress distribution across the section of thick cylinder? (7M)

7. a) Find the Euler's crippling load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm thick. Take length of the column as 2.3 m and hinged at its both ends. Take E=205 GPa. Also determine the crippling load by Rankine's formula using constants as 335 MPa and 1/7500? (7M)

   b) Write short notes on Slenderness ratio and limitation of Euler's formula? (7M)

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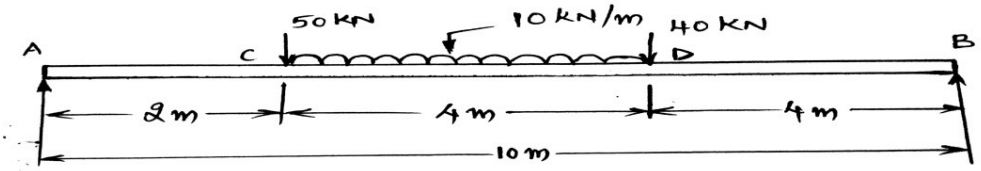
PART –A

1. a) What do you mean by "a bar of uniform strength"? (2M)
   b) What are the General sign conventions for shear force and bending moment in general? (2M)
   c) A wooden beam of 100 mm wide and 150 mm deep is simply supported over a span of 4 m. If shear force at a section of the beam is 4500 N, find the shear stress at a distance of 25 mm above the Neutral axis? (3M)
   d) What is a Macaulay's method? Where it is used? (2M)
   e) Define the term Polar Modulus? Find the expression for polar modulus for a solid shaft? (3M)
   f) What do you mean by Lame's equations? (2M)

PART -B

2. Two vertical rods one of steel and other of copper are each rigidly fixed at the top and 50 cm apart. Diameters and lengths of each rod are 2 cm and 4m respectively. A cross bar fixed to the rods at the lower end carries a load of 5000 N such that the cross bar remains horizontal even after loading. Find the stresses in each rod and the position of the load on the bar. Take E for steel = $2x10^5$ N/mm^2 and E for copper = $1x10^5$ N/mm^2. (14M)

3. A simply supported beam of length 10 m carries the uniformly distributed load and two point loads as shown fig. Draw the shear force and bending moment diagrams for the beam. Also calculate the maximum bending moment. (14M)



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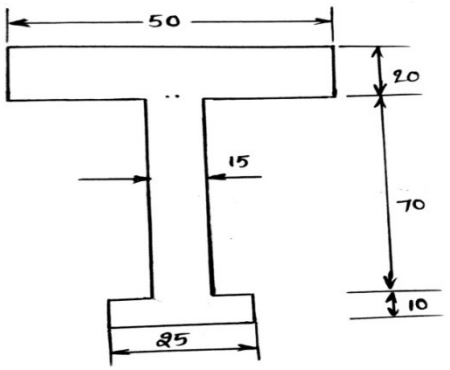
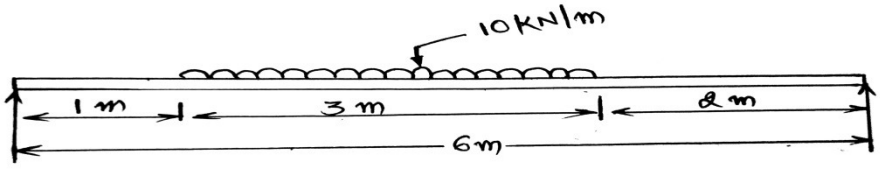
4. The cross-section of a beam is shown in fig. The beam is made of material with permissible stress in compression and tension equal to 100 Mpa and 140 Mpa respectively. (14M)



Calculate the moment of resistance of the cross-section, when subjected to a moment causing compression at the top and tension at the bottom.

5. A beam of length 6 m is simply supported at its ends. It carries a uniformly distributed load of 10 KN/m as shown in fig. Determine the deflection of the beam at its midpoint and also the position and the maximum deflection. Take EI= 4.5 x10^8 N/mm^2. (14M)



6. A closed cylindrical vessel made of steel plates 4 mm thick with plane ends, carries fluid under a pressure of 3N/mm^2. The diameter of the cylinder is 25 cm and length is 75 cm, calculate the longitudinal and hoop stress in the cylinder wall and determine the change in the in diameter, length and volume of the cylinder. Take E= 2.1x10^5 N/mm^2 and Poisson's ratios is 0.286. (14M)

7. Determine the crippling load for a T- section of dimensions 10 cm x10 cm x 2 cm and of length 5 m when it is used as strut with both of its ends hinged. Take young's modulus, E= 2.0 x10^5 N/mm^2. (14M)

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II B. Tech I Semester Regular/Supplementary Examinations, October/November - 2018
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PART –A

1. a) Define elasticity and plasticity? (2M)
   b) Write the types of loads? (2M)
   c) State the assumptions made in the theory of simple bending. (2M)
   d) Write Mohr's theorems? (3M)
   e) Define volumetric strain? (2M)
   f) Write the limitations of Euler's Formula? (3M)

PART –B

2. A bar of elastic material is subjected to directed stress in a longitudinal direction, and its strains in the two directions at right angles are reduced to one-half and one third respectively to those which normally occur in a ordinary tension member. If E=200kN/mm^2 and m = 4, what is the value of elastic constant? (14M)

3. Determine the shear force and bending moment diagrams for the cantilever loaded as shown in Figure: 1 (14M)

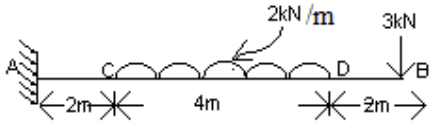

Figure: 1

4. a) A beam of symmetrical section 30cm deep and I= 12000cm^4, carries U.D.L. of 16kN/m. Calculate the maximum span of the beam if the maximum bending stress is not to exceed160N/mm^2. With this span, calculate the maximum central load if the bending stress is not to exceed the limit given above. (9M)
   b) From first principles show that the shear stress is not maximum at the neutral axis in case of an isosceles triangular section. (5M)

5. A beam of uniform section, 10 meters long, is simply supported at the ends. It carries point loads of 110 KN and 60 KN at distances of 2m and 5m respectively from the left end. Calculate: The deflection under each load and maximum deflection. Given: E = 200x10^{6}N/m^{2}and I = 118x10^{-4}m^4. (14M)

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6. a) Derive a formula for the proportional increase of capacity of a thin spherical shell due to an internal pressure. (5M)

   b) A cylindrical tank open at top and having vertical axis, is of 2.75 m inside diameter and 20 m high. The tank is filled with water and is made of structural steel with a yield point of 220 MN/ m^2. Determine the thickness of the tank if (i) longitudinal joint is 90% efficient and (ii) longitudinal joint is 70% efficient. Assume factor of safety as 3. (9M)

7. A solid shaft transmits 2000 kW at the 200 rpm. The maximum torque developed in the shaft is 1.8 times the mean torque. The distance between the bearings is 1.8 meters with a flywheel weighing 50 kN midway between the bearings. Determine the shaft diameter if (i) the maximum permissible tensile stress is 60 MPa (ii) the maximum permissible shearing stress is 40 MPa. (14M)

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Code No: R1621032 **R16** SET - 2

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PART –A

1. a) Write the types of stresses and strains? (2M)
   b) Define point of contra flexure? (2M)
   c) Define bending stress? (2M)
   d) Define slope, deflection and radius of curvature? (3M)
   e) Write about circumferential stress? (2M)
   f) Write about buckling and stability? (3M)

PART –B

2. a) Define proportionality limit, elasticity limit, yield stress and ultimate stress of a material? (4M)
   b) A circular rod of steel 14mm diameter is testing in a testing machine and it is found that when the tension is 18kN the total extension on a 21cm length is 0.15mm.Find the value of E. (10M)

3. A beam of length 6m is simply supported at its ends. It is loaded with a gradually varying load of 750 N/m from left end to 1500 N/m to the right end. Construct the SF and BM diagrams and find the magnitude and position of the maximum BM. (14M)

4. A simply supported rectangular beam is 150mm wide by 300mm deep carries a central concentrated load of 12KN and a distributed load of 8KN/m on a span of 3metres. Determine the maximum bending stress in the beam and bending stress at 1metre from the left end. (14M)

5. a) What is Macaulay's method for finding out the slope and deflection of a beam? (5M)
   b) A 3 meters long cantilever is loaded with a point load of 450 N at the free end. If the section is rectangular 80 mm (wide) x 160 mm (deep), and E = 10 GN/m^2, calculate slope and deflection. (i) at the free end of the cantilever, (ii) at a distance of 0.55 m from the free end. (9M)

6. A cylindrical shell of 200 mm diameter and 1 metre length is filled with a fluid at atmospheric pressure. The wall thickness is 8mm. If an additional 2 x 10^4 mm^3 of the fluid is pumped into the cylinder, find the pressure exerted by the fluid on the wall of the cylinder. Find also the hoop stress induced. E = 2 x 10^5 N/mm^2 ; Poisson's ratio = 0.3. (14M)

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7. A steel shaft of diameter 200 mm runs at 300 rpm. This steel shaft has a 30 mm thick bronze bushing shrunk over its entire length of 8 meters. If the maximum shearing stress in the steel shaft is not to exceed 12 MPa, find (14M)
   i) power of the engine
   ii) torsional rigidity of the shaft.
   Take G_{steel} = 84000 N/mm²; G_{bronze} = 42000 N/mm².

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Code No: R1621032 **R16** SET - 3

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2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1. a) Draw stress – strain diagram for mild steel? (2M)
   b) Define shear force and bending moment ? (2M)
   c) Define section modulus? (2M)
   d) What is moment area method? (3M)
   e) Write about longitudinal stress? (2M)
   f) Write about shafts in parallel? (3M)

PART –B

2. a) Define young's modulus, shear modulus and Bulk modulus. Derive the relation between them. (5M)
   b) The following data refer to a tensile test conducted on a mild steel bar : (9M)
   diameter of the specimen = 20 mm
   length of the specimen = 200 mm
   extension at a load of 40 kN = 0.12mm
   Load at yield point = 80kN
   Maximum load = 150 kN
   Total extension = 50 mm
   Neck diameter = 15 mm.
   Determine (i) young's modulus (ii) yield stress (iii) ultimate stress (iv) percentage elongation and (v) percentage reduction in area.

3. An overhanging beam of length 7m is supported centrally at two points 5m apart. It carries a uniformly increasing load of 400 N/m from the left end to 800 N/m at the midspan. It also carries a point load of 1000N at the right end. Draw the SF and BM diagrams and locate the point(s) of contra flexure. (14M)

4. The cross-section of a joist is a T-section 12.5 ×12.5×1.2cm with 12.5 cm side horizontal. Find the maximum intensity of shear stress and sketch the distribution of stress across the section if it has to resist a shear force of 90kN. (14M)

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5. a) A beam of length 6m is simply supported at the ends. It carries a uniformly distributed load of 4 kN/m over a length of 2 metres from the left end. Find the maximum deflection of the beam. (10M)
   Take E = 2 x 10^5 N/mm^2 and I = 2 x 10^7 mm^4.
   b) Write about double integration method? (4M)

6. a) Derive a formula for the hoop stress in a thin spherical shell subjected to an internal pressure. (4M)
   b) A cylindrical shell l0 m long and 50 cm in diameter and 12mm thick is at atmospheric pressure. What would be its dimensions when it is subjected to an internal pressure of 2 MN/ m^2? E = 200 GN/ m^2 and m = 4. (10M)

7. Derive an expression for the Euler's crippling load for a long column with following end conditions: (14M)
   (i) both ends are hinged (ii) both ends are fixed.

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Code No: R1621032 **R16** SET - 4

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2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

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PART –A

1.	a)	Define working stress and factor of safety?	(2M)
	b)	Write the types of beams?	(2M)
	c)	Write the equation of bending?	(2M)
	d)	Write the differential equation for the elastic line of a beam?	(3M)
	e)	Write Lame's equation?	(2M)
	f)	Write about shafts in series?	(3M)

PART –B

2.	a)	The piston of a steam is 40cm diameter and the piston rod diameter 6cm diameter. The steam pressure is 1.05 N/mm^2.Find the stress in the piston rod and the elongation of 75cm, taking E = 205kN/mm^2 when the piston is on the in-stroke.	(10M)
	b)	Write a note on impact loads?	(4M)
3.		A beam of length 6m is simply supported at its ends. It is loaded with a gradually varying load of 750 N/m from left end to 1500 N/m to the right end. Construct the SF and BM diagrams and find the magnitude and position of the maximum BM.	(14M)
4.		A 60cm× 20 cm I- joist has 2.5cm thick flanges and 1.8cm thick web. Calculate the maximum intensity of shear stress and sketch the distribution of stress across the section, the S.F. at the cross-section being 650kN.	(14M)
5.		A girder of uniform section and constant depth of 500 mm is freely supported over a span of 8 metres. Calculate the deflection for a uniformly distributed load on it such that the maximum bending stress induced is 90 N/ mm^2. Take E=2.04X10^5 N/mm^2. If for the above girder, the flanges are so portioned that there is uniform flange stress of 90 N/ mm^2 throughout the beam, calculate the central deflection.	(14M)

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6. a) A boiler shell is to be made of 15mm thick plate having a limiting tensile stress of 100 MN/m^2. If the longitudinal and circumferential efficiencies are 70% and 30% respectively, determine what maximum diameter of the shell would be allowed for a maximum pressure of 2 MN/ m^2. (7M)

   b) A vertical cylindrical gasoline storage tank, made of 20mm thick mild steel plate has to withstand maximum pressure of 1.5 MN/m^2. Calculate the diameter of the tank if stress if 240 MN/m^2, factor of Safety 2 and joint efficiency 70%. (7M)

7. Derive an expression for the shear stress produced in a circular shaft which is subjected to torsion. What are the assumptions made in the derivation? (14M)

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