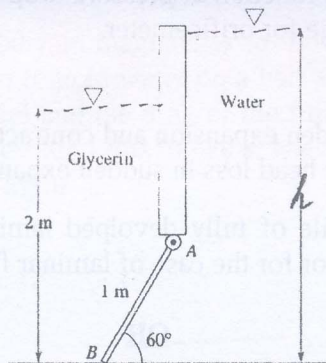


2023-24

B.Tech. End Term Examination
Automobile Engineering (Electric & Hybrid vehicle)
Fluid Mechanics-AEC2320

Maximum Marks: 60**Duration: Two Hours***Answer all the questions.**Assume suitable data if missing.**Notations used have their usual meaning.*

Q.No	Question	MM	COs
1(a)	Give one word answer: i. Slope of streamline ii. Newton's law of viscosity iii. Dimensions of kinematic viscosity	1x3	CO1
1(b)	Define the following terms: I. Incompressible flow II. Continuum	2x2	CO1
1(c)	Gate AB in Fig.1 is a homogeneous mass of 180 kg, 1.2 m wide into the paper, hinged at A, and resting on a smooth bottom at B. All fluids are at 20°C. For what water depth h will the force at point B be zero? (density of Glycerin=1260 kg/m ³)	8	CO1

Figure.1

2(a)	i. Define the term Control volume ii. Define the term Motion pressure iii. Write the expression for pressure normal to the streamline, if the streamline is straight.	1x3	CO2
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contd...2.

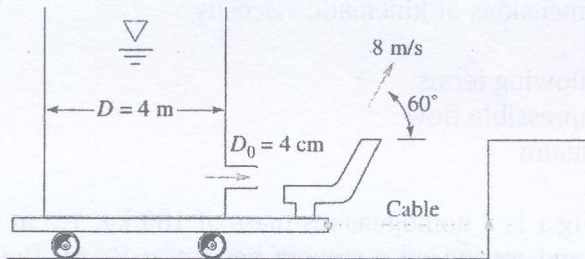
- 2(b) i. Give Physical interpretation of Reynolds Transport Theorem. 2x2 CO2
 ii. Differentiate between differential and integral approach.

- 2(c) Derive the Bernoulli's equation and write down all its assumptions applied while deriving the equation. Also write a note about its misused applications. 8 CO2

OR

- 2'(c) The water tank in Fig. 2 stands on a frictionless cart and feeds a jet of diameter 4 cm and velocity 8 m/s, which is deflected 60° by a vane. Compute the tension in the supporting cable. 8 CO2

Figure.2



- 3(a) i. Write the average velocity of laminar flow in a pipe. 1x3 CO3
 ii. Write the flow rate as a function of pressure drop in laminar pipe flow.
 iii. Coefficient of discharge for orificemeter.

- 3(b) i. Explain in brief the sudden expansion and contraction. 2x2 CO3
 ii. Derive the equation for head loss in sudden expansion.

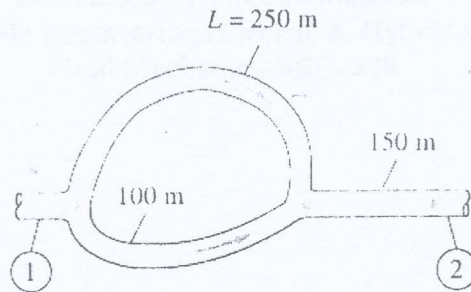
- 3(c) Derive the velocity profile of fully developed laminar flow in a circular pipe. Also find the friction factor for the case of laminar flow. 8 CO3

OR

- 3'(c) For the series-parallel system of Fig. 3, all pipes are 8-cm-diameter asphalted cast iron. If the total pressure drop $p_1 - p_2 = 750\text{ kPa}$, find the resulting flow rate $Q\text{ m}^3/\text{h}$ for water at 20°C . Neglect minor losses. ($\epsilon = 0.12\text{ mm}$) 8 CO3

contd....3,

Figure.3



- 4(a) Define the following term: 1x3 CO4
I. Lift
II. Drag
III. Grashof Number
- 4(b) Define the following term: 2x2 CO4
I. Kinematic similarity
II. Geometric similarity
- 4(c) The torque M required to turn the cone-plate viscometer depends upon the radius R , rotation rate Ω , fluid viscosity μ , and cone angle θ . Rewrite this relation in dimensionless form. How does the relation simplify if it is known that M is proportional to θ ? 8 CO4

OR

- 4'(c) A torpedo-shaped object 900 mm diameter is to move in air at 60 m/s and its drag is to be estimated from tests in water on a half scale model. Determine the necessary speed of the model and the drag of the full scale object if that of the model is 1.14kN. (Viscosities: air 1.86×10^{-5} Pa s, water 1.01×10^{-3} Pa s. Densities: air 1.20 kg/m^3 , water 1000 kg/m^3). 8 CO4
-

2023-24

**B.TECH. (AUTUMN SEMESTER) EXAMINATION
AUTOMOBILE ENGINEERING (ELECTRIC AND HYBRID VEHICLES)
LEAN METHODS FOR AUTOMOBILE ENGINEERS
AEC2750**

*Answer all the questions.
Assume suitable data if missing.*

Maximum Marks: 60

Credits: 04

Duration: Two Hours

Q.No.	Question	CO	MM
1(a)	i What is a lean operation?	CO1	01
	ii Who were the authors of the book 'The Machine That Changed the World' published in 1990?	CO1	01
	iii Produce in smaller volumes but in large variety is the concept of _____	CO1	01
1(b)	i Differentiate between traditional thinking and lean thinking.	CO1	02
	ii Write any four characteristics of lean manufacturing system (LMS).	CO1	02
1(c)	iii Show all the seven wastes in tabular form along with examples.	CO1	02
	Discuss in detail the concept of 'Value' & 'Waste'. What do you mean by 'Necessary non-value adding activities'? Give some examples to explain them.	CO1	06
OR			
2(a)	What do you mean by 'The Tangle' of Mura, Muri & Muda? Also discuss in detail the five elements of lean manufacturing through block diagram.	CO1	06
	i Designing and installing equipment that needs little or no maintenance is called Corrective Maintenance (True/False)	CO2	01
	ii What is Jishu Hozen?	CO2	01
2(b)	iii Draw a standard VSM diagram.	CO2	01
	Answer any THREE of the following:		
	i Compute the takt time for a system where the total time per shift is 480 minutes, there is one shift, and workers are given two 15-minute breaks and 45 minutes for lunch. Daily demand is 300 units.	CO2	02
	ii What are the six big losses to overall equipment effectiveness (OEE) and how it is calculated?	CO2	02
2(c)	iii What is Future State VSM ?	CO2	02
	iv List four benefits of 5S.	CO2	02
2(c)	What do you mean by Value Stream Mapping and Waste Visualization? What essential aspects you will take care of while designing/constructing a VSM?	CO4	06
OR			
2(c')	Calculate OEE from the following data taken from any manufacturing organization by a Lean Team. Also plot a bar or Pie chart to compare the	CO2	06

Contd...2

results obtained.

- A total of eight planned break times of 15 minutes each
- Two 20 minutes unplanned downtime due to a tooling failure and power failure
- Ideal rate of machine to run this part was determined to be 150 pieces/hour
- 15000 pieces produced per eight hours shift
- 2500 pieces were scrapped due to out of specification cause

3(a) i SMED:

- a. Allows conversion of small batch to single piece or small lot production
- b. Allows conversion of large batch to single piece or small lot production
- c. Prevention of defects by controlling the performance of a process
- d. Prevention of human errors from occurring in the production line

CO3 01

ii *c-Kanban* is also known as _____

CO3 01

iii What are 5W's and 2H's in 5W2H approach?

CO3 01

3(b) Answer any **THREE** of the following:

- i Construct Push and Pull methods of moving goods and materials through production systems.
- ii The county sheriff's department responded to an unusually large number of vehicular accidents along a quarter-mile stretch of highway in recent months. Prepare a cause-and-effect diagram for this problem.
- iii What is Poka Yoke? Give an example of it found in automobile industry.
- iv What is *Levelling* in JIT?

CO3 02

CO3 02

CO3 02

CO3 02

3(c) The operations manager of a firm that produces frozen dinners had received numerous complaints from supermarkets about the firm's Chick-n-Gravy dinners. The manager then asked her assistant, Annie, to investigate the matter and to report her recommendations. Annie identified five defects from complaints and the data resulted from inspection of these 15 frozen dinner samples is presented in the table below. Construct a Pareto diagram for the defects observed and what should Annie recommend to the manager?

Frozen Dinner Number	Defect observed				
	Underfilled	Missing Label	Spill/Mixed	Unaccep-table Taste	Improperly Sealed
FD-1		✓✓	✓	✓✓✓	
FD-2			✓✓		✓✓
FD-3				✓	✓✓✓
FD-4	✓✓		✓✓		✓
FD-5		✓✓	✓✓✓		✓
FD-6		✓✓✓		✓✓✓	
FD-7	✓		✓		✓✓

CO3 06

FD-8		✓✓✓		✓✓✓ ✓✓	
FD-9			✓		✓
FD-10			✓	✓✓	
FD-11	✓		✓		
FD-12				✓✓	✓✓
FD-13		✓✓✓	✓	✓✓✓	
FD-14					
FD-15	✓	✓✓✓	✓	✓	✓✓

OR

- 3(c) What are the five major steps of JIT implementation? List them.
 A JIT system uses Kanban cards to authorize movement of incoming parts. In one portion of the system, a work center uses an average of 100 parts per hour while running. The manager has assigned an inefficiency factor of 0.20 to the center. Standard containers are designed to hold six dozen parts each. The cycle time for parts containers is about 105 minutes. How many containers are needed? CO3 06
- 4(a) i Who quoted "*Without a standard, there can be no improvement*"? CO4 01
 ii What is '*Kaizen*'? CO4 01
 iii Lean leaders demonstrate leadership through their actions and ask the people to _____ CO4 01
- 4(b) i Differentiate between standardization & standardized work. CO4 02
 ii List the five steps of lean implementation. CO4 02
 iii What is a *Kaizen Event*? CO4 02
- 4(c) What do you understand by '*Lean Leadership*'? What actions they apply to lead the organization? Mention some essential characteristics of a lean leader? CO4 06

OR

- 4(c') Enumerate the principles of Kaizen implementation. Also discuss the three different types of Kaizen used for continuous improvement in manufacturing organizations. CO4 06

2023-24
B.TECH. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL / AUTOMOBILE ENGINEERING
EXPERIMENTAL METHODS AND ANALYSIS
MEA2420 / AEA2420

Maximum Marks: 60

Credits: 04

Duration: Two Hours

*Answer all the questions.**Assume suitable data if missing.**Statistical Tables are allowed.**Notations used have their usual meaning.*

Q. No.	Question	CO	MM
Q1. (a) i.	A ship has two turbo engines operating independently. The probability that an engine is available when needed is 0.90. What is the probability that neither is available when needed?	CO1	[1.0 x 3]
ii.	Find the value of 'z' if the area under a standard normal curve to the left of z is 0.0526.		
iii.	Using Poisson distribution find the value of $p(4;6.5)$.		

- (b) Attempt any two of the following: CO1 [2.0 x 2]
- It is known that 90% of chromium plated watches are corrosion resistant. For the ten randomly selected chromium plated watches, what is the probability that 7 may not be found corrosion resistant?
 - In a certain assembly plant, two machines, M1 & M2 make 40% & 60% respectively, of the products. From past experience 2% & 3% of the products made by each machine respectively, are defective. What is the probability that if a product is randomly selected it is defective?
 - Let X be that no. of cash registers being used at a particular time for location-1 and Y the no. of cash registers being used at the same time for location-2. The joint probability function is given by

		y		
		0	1	2
x	0	0.12	0.04	0.04
	1	0.08	0.19	0.05
	2	0.06	0.12	0.30

Find the expected no. of cash registers used at location-2.

- (c) Attempt any two of the following: CO2 [4.0 x 2]
- A 3D printer is used to make paperweight of 100 grams. The mass production of the item shows that mean is 100grams with standard deviation 5 grams. What percentage of the products may be made between 90 to 110 grams?
 - On a railway reservation counter, on average, 20 people arrives each hour. Find the probabilities that in a 30-minute period 5 people may arrive; and in another 30-minute period nobody shall arrive at the reservation counter.

contd... 2.

- iii. The probability that a patient recover from a delicate heart operation is 0.9. Of the next 100 patients having this operation, what is the probability that between 84 to 94 inclusive survive.

- Q2. (a) i. Find $P(t > -2.567)$ when $\nu = 17$ CO1 [1.0 x 3]
 ii. Find $\chi^2_{0.95}$ when $\nu = 25$
 iii. Find $F_{0.95}$ with $\nu_1 = 10$ and $\nu_2 = 12$

- (b) i. A maker of certain brand of low fat cereal bars claim that the average saturated fat content is 0.5 grams with a variance of 0.09 grams. In a random sample of 8 cereal bars of this brand, what is the probability that mean of the sample may be more than 0.52 grams? CO2 [2.0 x 2]
 ii. A manufacturing firm claims that the batteries used in cars will last on average of 4 years with standard deviation of 0.5 years. What is the probability that variance of 9 such batteries may be more than 0.9 years?

- (c) The following measurements were recorded for the drying time, in hours, of a certain brand of latex paint: CO2 [8.0]

3.4, 2.5, 4.8, 2.9, 3.6,
 2.8, 3.3, 5.6, 3.7, 2.8,
 4.4, 4.0, 5.2, 3.0, 4.8.

Assuming that the measurements represent a random sample from a normal population, find a 95% confidence interval for mean drying time and its variances.

OR

- (c') An EV firm manufactures batteries with the backup of driving time approximately normally distributed with mean 8 hours and a standard deviation of 0.4 hours. If a random sample of 30 such batteries has shown driving time of 7.5 hours. Will the claim of the manufacturer is correct that the batteries have a backup of not less than 8 hours driving time? Comment on the decision. CO2 [8.0]

- Q3. (a) Define briefly the following performance characteristics of instruments: CO3 [3.0]
 i. Tolerance
 ii. Time constant in first order instruments
 iii. Hysteresis in instruments

- (b) i. A pressure transducer has an input range of 0 to 10^4 Pa and an output range of 4 to 20 mA at a standard ambient temperature of 20 °C. If the ambient temperature is increased to 30 °C, the range changes to 4.2 to 20.8 mA. Quantify this environmental effect as zero drift and sensitivity drift. CO3 [2.0 x 2]
 ii. Define Operational Transfer Function (OTF) of the measurement system with the help of a diagram.

- (c) Attempt any two (02) of the following: CO3 [4.0 x 2]

- i. **Explain the compensation technique** for improving the dynamic characteristics of first order instruments with the help of a neat diagram. **Derive** the governing equation for the compensated system.

- ii. An unmanned submarine is equipped with temperature and depth measuring instruments and has radio equipment that can transmit the output readings of these instruments back to the surface. The submarine is initially floating on the surface of the sea with the instrument output readings in steady state. The depth measuring instrument is approximately zero order and the temperature transducer first order with a time constant of 50 seconds. The water temperature on the sea surface, T_o is 20°C and the temperature T_x at a depth of 'x' meters is given by the relation, $T_x = T_o - 0.01x$. If the submarine starts diving at time zero, and thereafter goes down at a velocity of 0.5 m/sec, **find the temperature and depth measurements** reported after 200 seconds of travel.

- iii. **Formulate** the system equation for "Liquid in glass thermometer" relating the output signal in the form of displacement of liquid in the capillary tube and the input temperature of the fluid, surrounding the bulb of thermometer.

Q4. (a) **Fill in the blanks:**

CO4 [3.0]

- i. In semiconductor strain gauges, _____ term is large thus giving large gauge factors.
- ii. Two commonly used LED materials are _____ and _____.
- iii. Pirani gauge is a device that measures the pressure through the change in _____ of the gas.

(b) i. What are **dynamometers** used to measure? **Name** three (03) types of dynamometers. CO4 [2.0 x 2]

ii. A **Knudsen gauge** is to be designed to operate at a maximum pressure of $1.0 \mu\text{m Hg}$. For this application the spacing of the vane and plate is to be less than 0.3 times the mean free path at this pressure. **Calculate** the force on the vanes at pressures 1.0 and $0.01 \mu\text{m Hg}$, when the gas temperature is 20°C and the temperature difference is 50.0 K .

(c) **Attempt any two (02) of the following:**

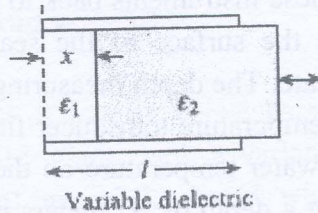
CO4 [4.0 x 2]

i. Why **Automatic Reference Junction Compensation** is employed in thermocouples? An iron-constantan thermocouple is to be used to measure temperatures between 100 and 300°C . The e.m.f. values are given as $E_{100,0} = 5269 \mu\text{V}$ and $E_{300,0} = 16327 \mu\text{V}$. The e.m.f. is $12500 \mu\text{V}$ relative to a reference junction of 20°C and the corresponding reference junction

contd...4.

circuit voltage is $1000 \mu\text{V}$. Assume a linear e.m.f. vs temperature characteristics to **estimate the measured junction temperature.**

- ii. **Derive a relation for the capacitance in the capacitive transducer shown in the figure below with variable dielectric.**



- iii. **Explain the working of Counter type analog to digital convertor with the help of a neat diagram.**

**B.TECH. (ODD SEMESTER) EXAMINATION
MECHANICAL/AUTOMOBILE ENGINEERING
MECHANICS OF SOLIDS
MEC2110/AEC2110**

Maximum Marks: 60

Credits: 04

Duration: Two Hours

Answer all questions.

Assume suitable data if missing.

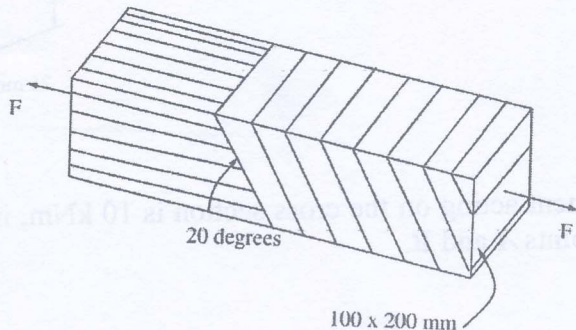
Notations used have their usual meaning.

Take units in SI system if not specified.

- | Q.No. | Questions | [MM]
[CO] |
|-------|--|---------------|
| 1(a) | In the given figures, motion of three different bodies are shown. The solid line represents initial position and dashed line represents final position of the same body. Which one of the three bodies undergoes rigid body translation only. | [01]
[CO1] |
| 1(b) | A square shape deforms into four different shapes as shown. Which one is not a case of uniform strain? (There may be more than one answers.) | [01]
[CO1] |
| 1(c) | How many independent components are there in stress tensor if body moments are present? | [01]
[CO1] |
| 1(d) | Draw a free-body diagram of a bicycle, isolating it from the road and the rider. | [02]
[CO1] |
| 1(e) | If the motion of a body is given as
$u = 0.01 \sin\left(\frac{\pi x}{2L}\right) + 0.005 \cos\left(\frac{\pi y}{2L}\right)$ $v = 0.02 \cos\left(\frac{\pi x}{2L}\right) + 0.03 \sin\left(\frac{\pi y}{2L}\right)$ where, L is a constant. Determine if the body is in a state of uniform strain or not. Also, Find the strain components at location $x = L/2$ and $y = L$. | [04]
[CO1] |
| 1(f) | Consider a body in a state of plane stress such that $\sigma_{xx} = x^2 \text{ N/m}^2$ and $\sigma_{yy} = y^2 \text{ N/m}^2$. If the body is in equilibrium in the absence of body force, determine σ_{xy} . | [06]
[CO1] |

OR

- 1(f) Two pieces of wood are to be glued together using a lap joint as shown. The shear strength of the glue is 10 N/mm^2 . Find the maximum permissible load F , so that the joint will not fail in shear.



[06]
[CO1]

- 2(a) Choose the correct option
- (i) Total strain = Thermal Strain + Mechanical Strain
 - (ii) Thermal Strain = Total Strain + Mechanical Strain
 - (iii) Total Strain = Mechanical Strain - Thermal Strain
 - (iv) It depends upon the problem

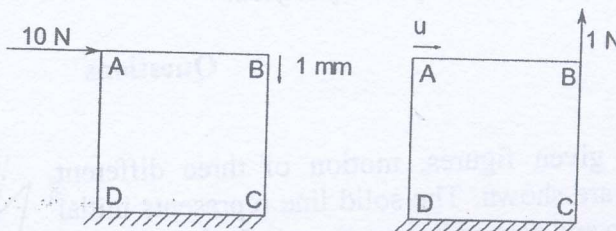
[01]
(CO2)

- 2(b) State whether the following statements are correct or not. If incorrect, re-write the correct statement.

[01+01]
(CO2)

- (i) Plane strain problem means that there is no force in out-of-plane direction.
- (ii) In case of plane stress problems, the in-plane forces may vary in the direction of normal to the plane

- 2(c) If a 10 N force is applied at corner A of square ABCD as shown, the corner B displaces by 1 mm downwards. What would be the displacement u of corner A towards right if the an upward force of 1 N is applied at corner B.



[02]
(CO2)

- 2(d) A rod of length L is fixed at one end and is applied by a torque T_1 at other end. Another torque T_2 is applied in the middle of the rod. Determine the angle by which the end (where T_1 is being applied) will twist in terms of applied toques, length L , shear modulus G and polar moment of area I_p of the cross-section.

[05]
(CO2)

- 2(e) Determine the strain energy expression of a rod hanging under gravity. (Take: A as cross-sectional area, E as Young's modulus, L as length, and $\rho g A$ as force per unit length)

[05]
(CO2)

OR

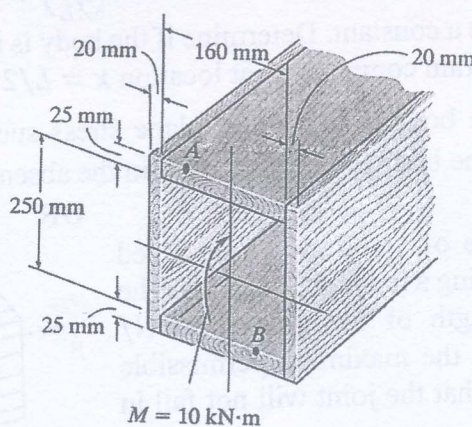
- 2(e') Derive the critical buckling load expression for the buckling of a column with both ends pinned.

[05]
(CO2)

- 3(a) What does the area of the shear force diagram represent?
If the shear force in a beam is maximum at a certain point, what can be said about the bending moment?

[01+01]
(CO3)

- 3(b) A box beam is constructed from four pieces of wood, glued together as shown. Determine the second moment of area of the box beam.



[02]
(CO3)

- 3(c) If the moment acting on the cross section is 10 kNm, in question 3 (b) determine the stress at points A and B.

[02]
(CO3)

3(d) For steel structures, why are I section beams preferred to other shapes?

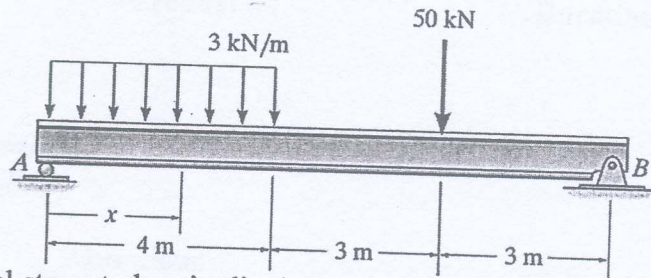
[01]
(CO3)

3(e) A simply supported beam, 8 m long, carries two concentrated loads of 80 kN and 60 kN at distances of 3 m and 6 m from the left end, respectively. Calculate the slopes and deflections at the ends under the loads. $E = 200 \text{ GPa}$ and $I = 3 \times 10^{-4} \text{ m}^4$.

[8]
(CO3)

OR

3(e)' Determine the equation of the elastic curve for the beam subjected to the load shown in figure.



[8]
(CO3)

4(a) What is the ratio of circumferential stress to longitudinal stress in a thin cylinder subjected to internal hydrostatic pressure?

[01]
(CO4)

4(b) A thin walled water pipe carries water under a pressure of 2 N/mm^2 and discharges water into a tank. Diameter of the pipe is 25 mm and thickness is 2.5 mm. What is the longitudinal stress induced in the pipe?

[01]
(CO4)

4(c) The circumferential stress in a cylindrical steel boiler shell under internal pressure is 80 MPa. Young's modulus of elasticity and Poisson's ratio are 200 GPa and 0.28 respectively. Determine the magnitude of circumferential strain in the boiler shell.

[02]
(CO4)

4(d) Determine the maximum shear stress induced in a thin-walled cylindrical shell having an internal diameter 'D' and thickness 't' when subject to an internal pressure 'p'.

[02]
(CO4)

4(e) Circumferential and longitudinal strains in a cylindrical boiler under internal steam pressure are ϵ_1 and ϵ_2 respectively. What will be the change in volume of the boiler cylinder per unit volume?

[01]
(CO4)

4(f) A compound cylinder is formed by shrinking a tube of 250 mm internal diameter and 25 mm wall thickness onto another tube of 250 mm external diameter and 25 mm wall thickness, both tubes being made of same material. The stress setup at the junction owing to shrinkage is 10 MN/mm^2 . The compound tube is then subjected to an internal pressure of 80 MN/mm^2 . Compare the hoop stress distribution now obtained with that of a single cylinder of 300 mm external diameter and 50 mm thickness subjected to the same internal pressure.

[08]
(CO4)

OR

4(f)' A closed cylindrical shell with an internal diameter of 500 mm and an external diameter of 600 mm measures 2 m in length and experiences an internal pressure of 10 MPa. Illustrate the radial and hoop stress distribution throughout the thickness. Calculate the change in internal volume and thickness. The material properties are $E = 200 \text{ GPa}$ and $\nu = 0.3$.

[08]
(CO4)