



ELIZADE UNIVERSITY, ILARA-MOKIN,
ONDO STATE, NIGERIA

DEPARTMENT OF AUTOMOTIVE ENGINEERING

FIRST SEMESTER EXAMINATIONS

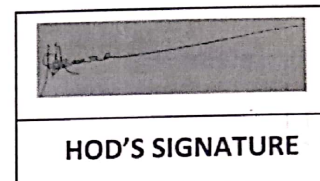
2019/2020 ACADEMIC SESSION

COURSE: ATE 303 – Vehicle Structures (3 Units)

CLASS: 300 Level Automotive Engineering

TIME ALLOWED: 3 Hours

INSTRUCTIONS: Answer **Question 1** and any other **Four Questions**. Only short answers are required for each item in Question 1. **Date:** February, 2020



Question 1

1. Explain the interrelation between 'Loads', 'Design' and 'Structures' in the study of Vehicle Structures
2. State three methods of quantifying dynamic or static load on a vehicle for use in design
3. Use a sketch to illustrate asymmetric loading
4. Explain how stiffness factors are applied in vehicle structure's design
5. Sketch any of the vehicle structure frames and describe its features briefly
6. State the criteria normally used for selecting materials for vehicle body
7. Use a sketch to describe how the SSS method is used in analysis of vehicle structures
8. For any of the vehicle layout components under Chassis category, list three sub-elements
9. Explain the differences between bending load and torsional load
10. What are the consequences of low torsional stiffness of a vehicle structure?
11. How is centrifugal load accounted for on a vehicle?
12. When do we experience vibration load on a vehicle?
13. State practical cases of combined torsional and asymmetrical loading

Question 2

The Figure 1 shows a vehicle under combined bending and torsion loads.

- a) Name all the reaction forces R_x shown
- b) Explain how these reactions can be calculated
- c) Using the boxes shown, explain how the vehicle responds to the combined loading. *Note: Number the boxes as (1), (2), (3), (4) from left to right*

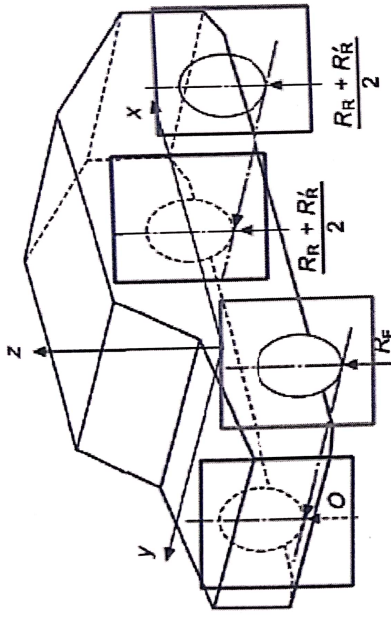


Figure 1

Question 3

Figure 2 illustrates the Chassis for an Integral Structure.

- Draw the sketch on your Answer paper
- Label the key components of this structure
- State the features of this structure in respect of geometry and stress distribution
- What are the main advantages of the structure?

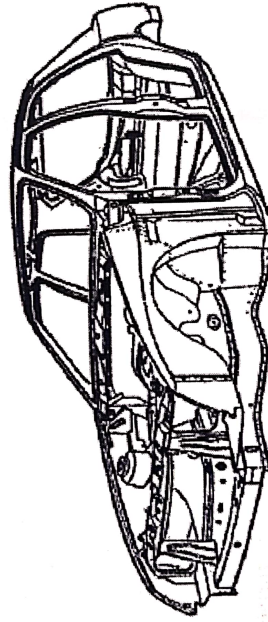


Figure 2

Question 4

Figure 3 shows SSS elements of half-saloon car under bending.

- Name the surfaces labeled SSS5, SSS6 and SSS7
- Draw their free body diagrams (FBD's)
- Write their equilibrium equations

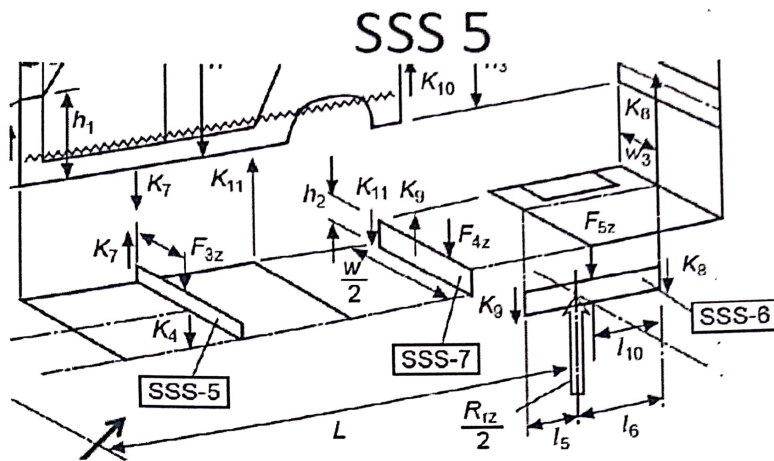


Figure 3

Question 5

Figures 4(i) and 4(ii) show the strength-of-materials analysis for SSS elements of a saloon car comprising: (i) front suspension tower and (ii) rear seat cross beam.

- (a) Derive the equations for calculating the side shear forces shown, i.e. K_B , K_R for 4(i) and K_K for 4(ii). Note the coordinate y represents the relative locations of the positions
- (b) State the design implications of the results for each of them

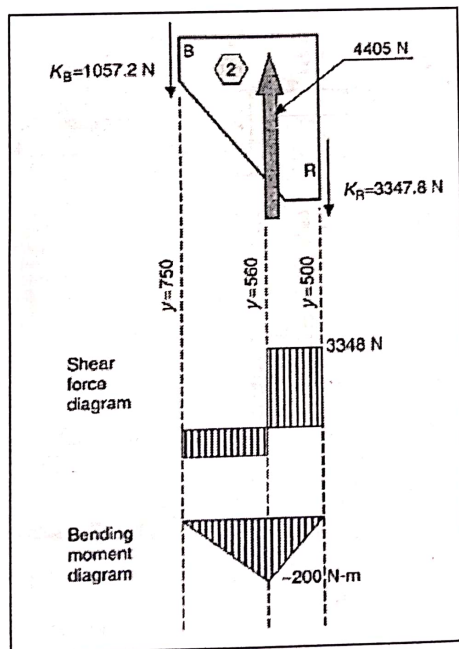


Fig 4(i)

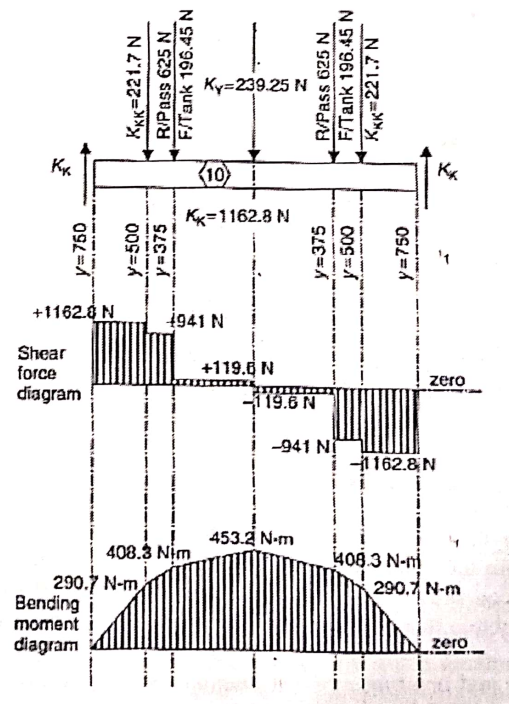


Fig 4(ii)

Question 6

Figure 5 shows SSS elements of a half-saloon car under bending.

- d) Name the surfaces labeled SSS1, SSS2, SSS3 and SSS4
- e) Draw their free body diagrams (FBD's)
- f) Write their equilibrium equations

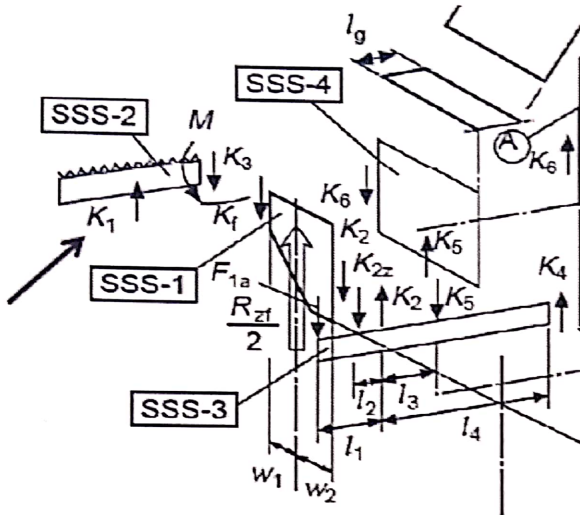


Figure 5

Question 7

- (a) The main components of an automobile can be sub-grouped in the following assemblies
 - i. Engine or power plant
 - ii. Running gear or basic structure
 - iii. Driving system
 - iv. Basic Control system
 - v. Electrical system
 - vi. Accessories

State two items in any two of these categories

- (b) Figure 6 is schematic of a 4-wheel drive.
 - i. Sketch and label the top view (i.e. second one below)
 - ii. Describe briefly the key features of this drive system

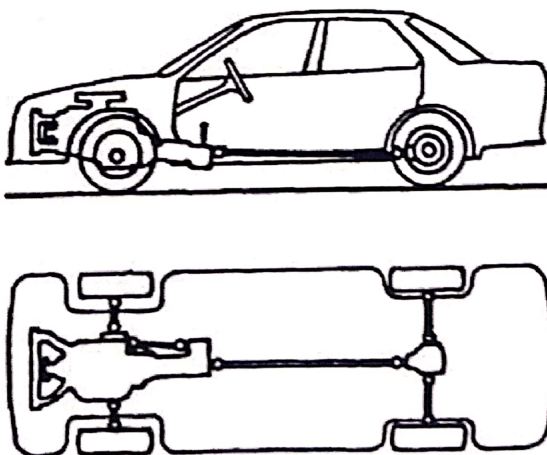


Figure 6