ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE, NIGERIA

DEPARTMENT OF AUTOMOTIVE ENGINEERING

FIRST SEMESTER EXAMINATIONS

2020/2021 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 from Questions 2 to 7.
Question 1 is Compulsory and only short answers are required.

Date: March, 2021

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. Sketch any of the vehicle structure frames and describe its features briefly
5. State the criteria normally used for selecting materials for vehicle body
6. Use a sketch to describe how the SSS method is used in the analysis of vehicle structures
7. For any of the vehicle layout components under Chassis category, list three sub-elements
8. Explain the differences between bending load and torsional load
9. What are the consequences of low torsional stiffness of a vehicle structure?
10. How is centrifugal load accounted for on a vehicle?
11. When do we experience vibration load on a vehicle?
12. State practical cases of combined torsional and asymmetrical loading
13. Explain the safety requirement for a vehicle structure
14. List the materials commonly used in vehicle structures
15. Distinguish between strength and stiffness of a vehicle structure
16. Define dynamic load factor and compare it with factor of safety

Question 2

Figure 1 below 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*
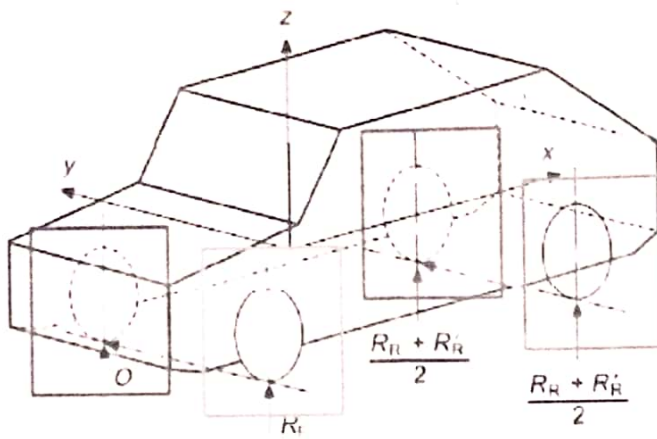
Figure 1

Question 3
Figure 2 below illustrates the Chassis for an Integral Structure.
a) Draw the sketch on your Answer paper
b) Label the key components of this structure
c) State the features of this structure in respect of geometry and stress distribution
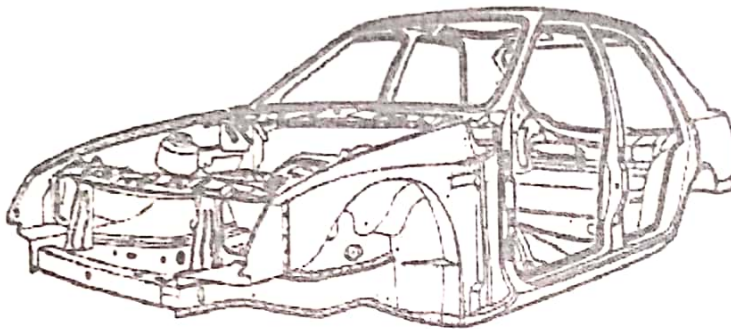d) What are the main advantages of the structure?

Figure 2

Question 4
Figure 3 below shows SSS elements of half-saloon car under bending.
a) Write the names of the surfaces labeled SSS5, SSS6 and SSS7
b) Draw their free body diagrams (FBD's)
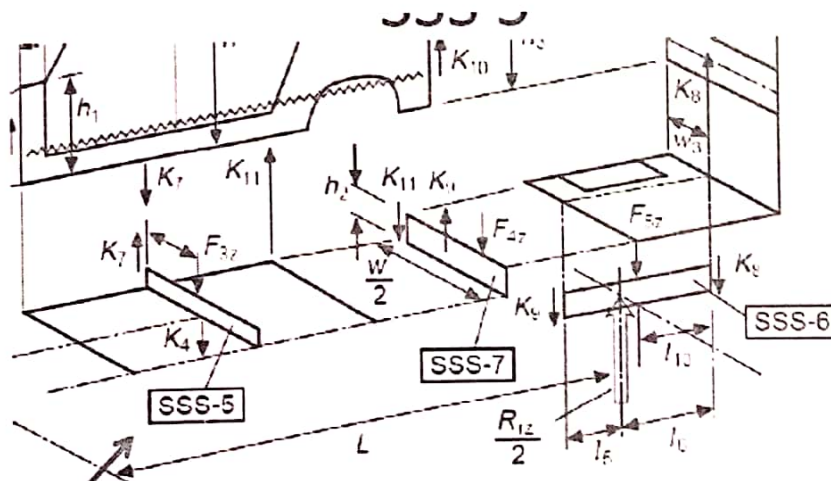c) Write their equilibrium equations

Figure 3

Question 5

Figures 4(i) and 4(ii) show the equilibrium 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_P for 4(i) and K_K for 4(ii). *Note the coordinate y represents the relative locations of the positions*

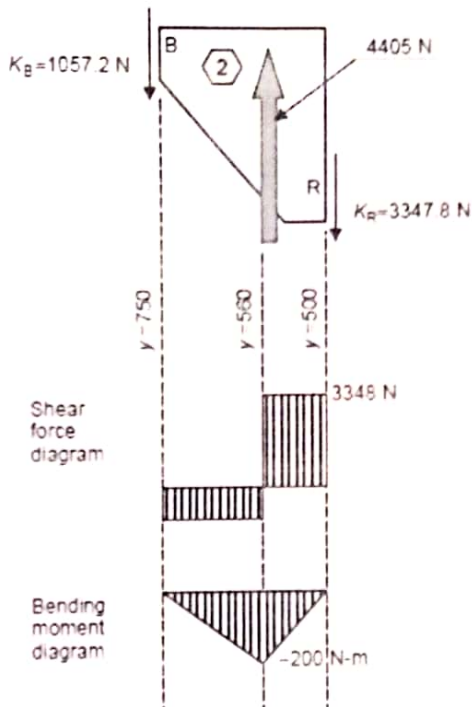*(b)* State the design implications of the results for each of them
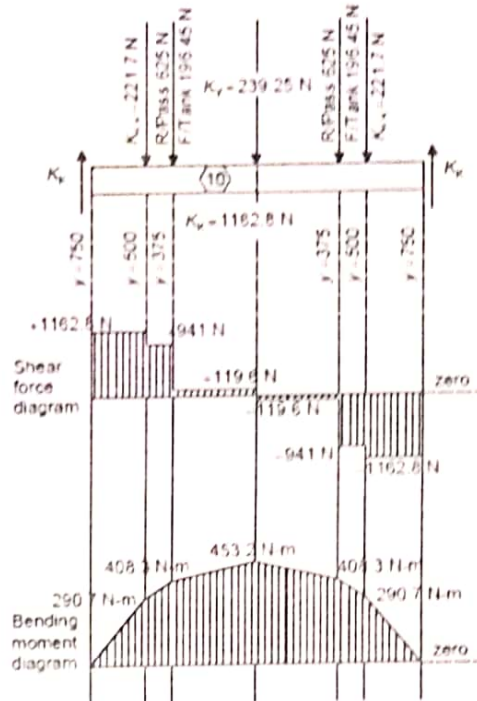

Fig 4(i)

Fig 4(ii)

Question 6

(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 5 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
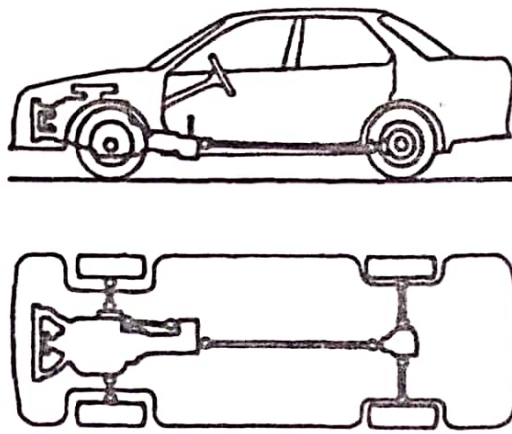
Figure 5

Question 7

Figure 6 below shows the design case for a vehicle under bending loads. Do the following:
a) Sketch the figure with full labels
b) Name the applied loads and the reaction forces
c) Use the figure to obtain the equilibrium equations
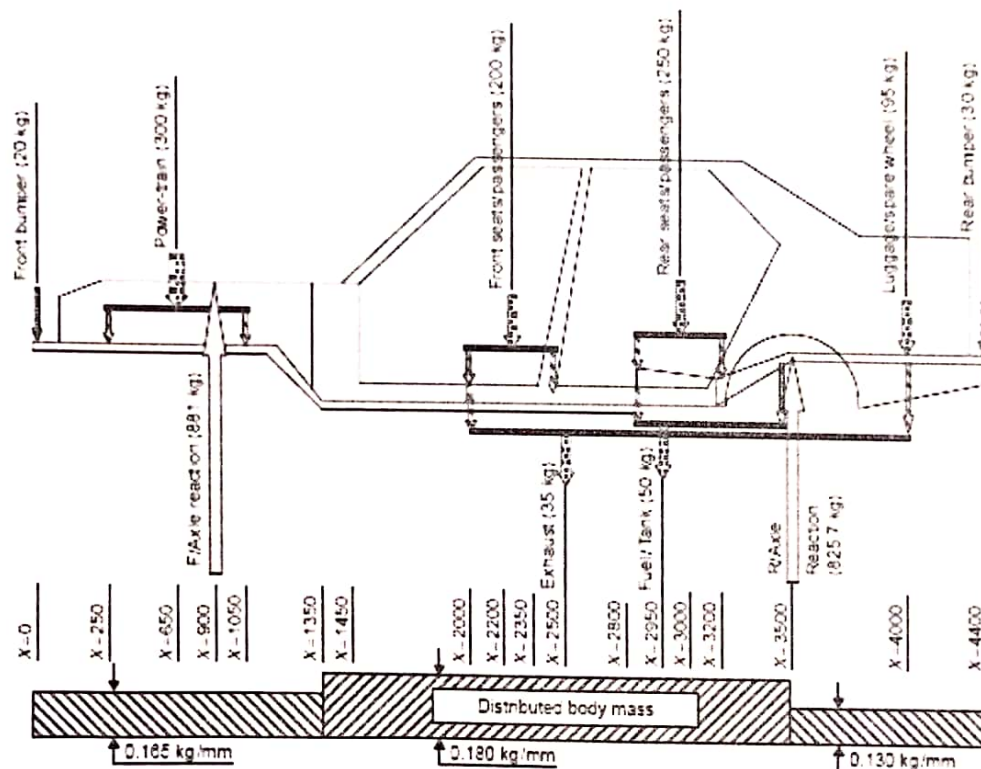d) Sketch the shear force diagram

Figure 6