



ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE,
NIGERIA

DEPARTMENT OF AUTOMOTIVE ENGINEERING

SECOND SEMESTER EXAMINATIONS

2017/2018 ACADEMIC SESSION

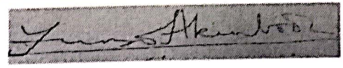
COURSE: ATE 302 – POWERTRAIN, NOISE, VIBRATION & HARSHNESS
(2 Units)

CLASS: 300 Level Automotive Engineering

TIME ALLOWED: 3 Hours

INSTRUCTIONS: Answer Question 1 and any 3 questions from Qu. 2 to Qu. 6.

Date: July/August, 2018



HOD'S SIGNATURE

Question 1

- i. What are the elements which constitute a powertrain system?
- ii. Describe the role of gears in power transmission in automotive system
- iii. State the differences between the *drive mechanism* of manual transmission and automatic transmission in an automobile.
- iv. What is the range of efficiency of a manual transmission system? What are means of improving the efficiency?
- v. What is the link between Powertrain and NVH?
- vi. What is the significance or necessity for controlling NVH in an automotive system?
- vii. What techniques are used for measuring the severity of NVH?
- viii. List three types of interior noise in an automotive system
- ix. What are the basic types of vibration?
- x. Define transmissibility of forced vibration for a moving vehicle
- xi. What is the relation between transmissibility of vibration and resonance?
- xii. Explain how tyres transmit vibration in automotive system using a car or truck for illustration

Question 2

Figure 1 below shows the front suspension of an automobile.

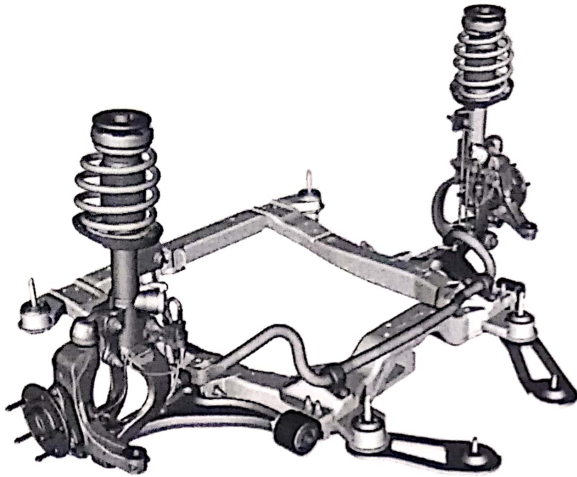


Figure 1

For this system, do the following:

- Explain how each component contributes to vibration isolation or control
- State how each component can wear out or fail
- Use a sketch to show that the system can be modeled as a single degree of freedom system
- Write the differential equation of motion for the system including external forcing function
(Note: Do not solve the equation nor state the solution)

Question 3

Common types of noise in automotive systems are

- Engine noise
- Intake and exhaust noise
- Aerodynamic noise
- Tyre noise

For each type of noise, do the following:

- Describe the characteristics of the noise, including the sources
- State means of controlling it

Question 4

Figure 2 below shows a torque converter used in automatic transmission.

- State the key components of the torque converter
- Describe how the torque converter works, including its fluid coupling operation.

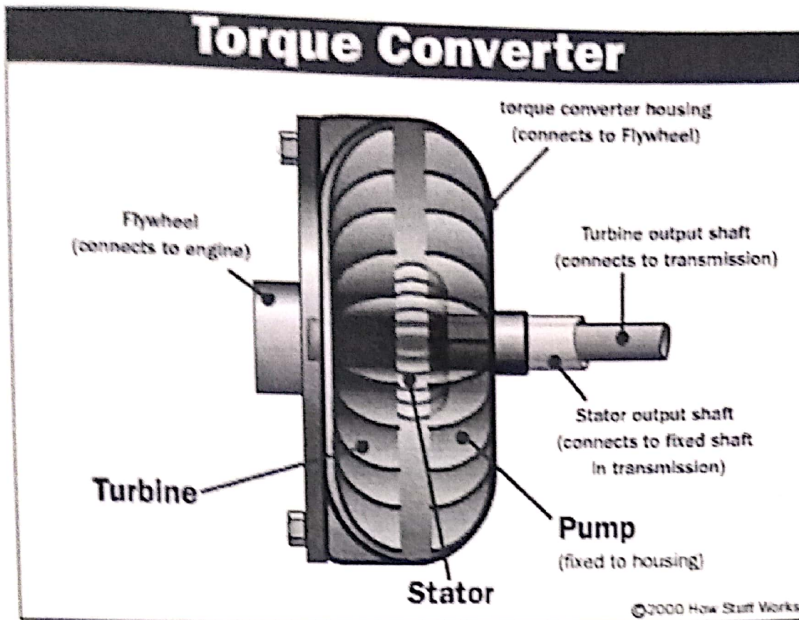


Figure 2

Question 5

Figure 3 below shows a five-speed manual transmission system

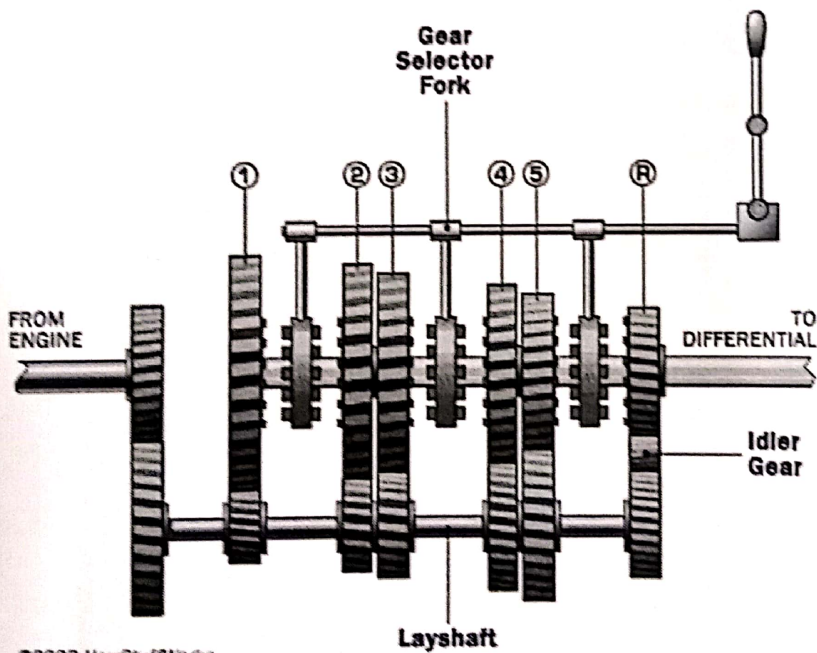


Figure 3

- Sketch Figure 3
- Identify the components shown
- Describe how the entire system works
- Explain how the Idler gear works
- Explain the function of the synchronizers (Note: These are not shown in Figure 3)

Question 6

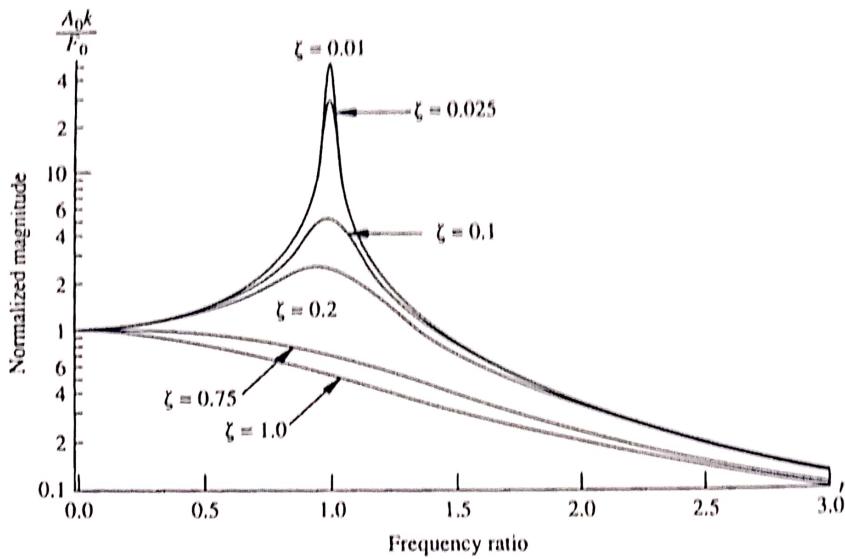


Figure 4a

The graph in Figure 4a above shows the amplitude transmissibility ratio, A , as a function of frequency ratio, r , for various damping ratios, ζ , which can be expressed in the form:

$$A = f(r, \zeta) = \sqrt{\frac{4r^2\zeta^2 + 1}{r^4 + (4\zeta^2 - 2)r^2 + 1}}$$

- Write the standard expressions for r and ζ
- Explain the characteristics of the graphs in respect of increasing damping ratio, ζ . Use Fig 4b as aid for this.
- What is the significance of the case of $r = 1$?
- Sketch the limiting case of no damping, i.e. for $\zeta \rightarrow 0$
- Using the formula above, show that for transmission isolation, r must be greater than $\sqrt{2}$.

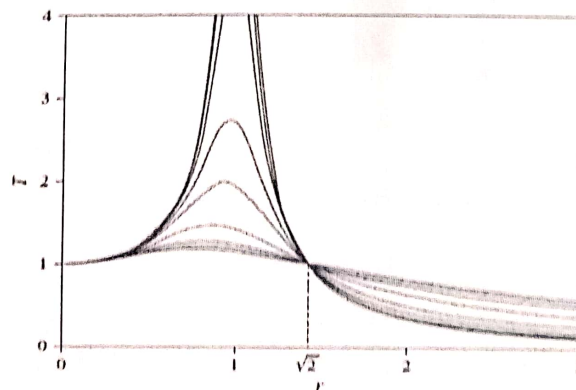


Figure 4b