University of Ruhuna- Faculty of Technology

Bachelor of Engineering Technology Honours Degree
Level 2 (Semester II) Examination, December 2023
Academic Year 2021/2022

Course Unit: ENT 2242 Basic Automobile Technology (Written) **Duration: 2 hours**

- All symbols have their usual meanings.
- There are five questions in the paper.
- Answer only **Four (04)** questions.
- Calculators are allowed for this examination.

Question 1 (25 marks)

1. Name three self – propelled vehicles. (3 marks)
2. Sketch the anatomy of a front wheel drive automobile and name any 5 components (5 marks)
3. What does it mean by the comfort system of an automobile (2 marks)
4. Briefly explain how a hydraulic clutch system works to engage and disengage the clutch to link and delink the engine and gear box. (5 marks)
5. When the gear ratio of an automobile is changed while the vehicle is being driven, the gear crashing should be avoided. State the requirement to avoid gear crashing and an existing mechanism of avoiding it. (5 marks)
6. Suggest the adverse effects if a catalytic converter is not installed in the exhaust system of an automobile. (5 marks)

Question 2 (25 marks)

1. What is air – fuel ratio? (2 marks)
2. Explain the function of the following components of the fuel system in an SI engine.
   I. Fuel Pipes
   II. Fuel Filters
   III. Air Filters
   IV. Fuel Pump
   V. Carburetor (5 marks)
3. Write three types of carburetors used in automobiles (3 marks)

4. Write down two defects of the Simple Carburetor.

(2 marks)

5. Write down five components that have been added to the simple carburetor to mitigate the drawbacks.

(5 marks)

6. Identify the following system of a carburetor shown in Figure Q2. Explain its function in the carburetor

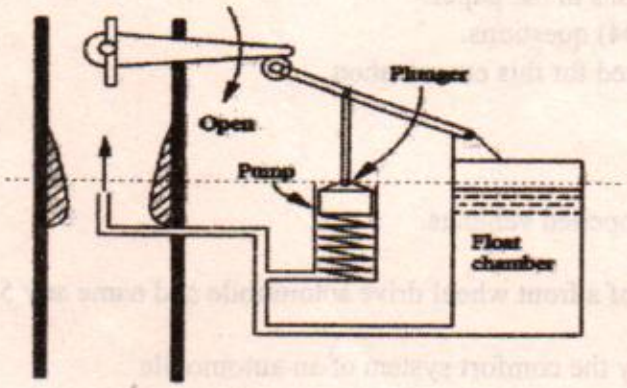

Figure Q2

(5 marks)

7. What is the function of the choke in a carburetor?

(3 marks)

Question 3 (25 marks)

1. State the purpose of Morse Test?

(2 marks)

2. Briefly explain what is a Rope Brake Dynamometer?

(2 marks)

3. Following formula gives the Brake Power of a Rope Brake Dynamometer? Name what N, W, S, R and r are.

$$Break\ power = \frac{2\pi N(W-S)(R+r)}{60}$$

(5 marks)

4. A single cylinder, four stroke cycle engine is fitted with a rope brake. The diameter of the brake wheel is 0.6 m and the rope diameter is 0.026 m. The dead load (Weight) on the brake is 200 N and the spring balance reads (Reading on scale) 30 N. If the engine runs at 450 r.p.m. (RPM of shaft) what will be the brake power of the engine?

(6 marks)

5. A 4-cylinder four-stroke petrol engine develops 14.7 kW at 1000 r.p.m. The break mean effective pressure is 5.5 bar, calculate the bore and stroke of the engine, if the length of stroke is 1.5 times the bore.
(Note: 1bar = 1×10^5 N/m^2)

(10 marks)

Question 4 (25 marks)

1. A simple disk clutch with one driving and one driven surface as shown in Figure Q4. Driving friction between the two develops when they are forced together. Equations can be developed using two different basic assumptions. Those assumptions are uniform distribution of interface pressure and uniform rate of wear at interface.

   (a) Derive and show that the equation of total normal force acting on the area of contact is $F = \pi p(r_o^2 - r_i^2)$ using uniform pressure theory. (Label all the parameters)

   (06 marks)

   (b) Derive and show that the friction torque that can be developed on a ring element is $T = \frac{2\mu F(r_o^3 - r_i^3)}{3(r_o^2 - r_i^2)}$ using uniform pressure theory. (Label all the parameters)

   (08 marks)

   (c) The clutch is employed to connect an electric motor, running uniformly at 840 r.p.m. with an initially stationary flywheel. The flywheel has a mass (m) of 10 kg and its radius of gyration (k) is 200 mm. The contact surfaces in a disc clutch have an inner diameter (D_i) of 80 mm and outer diameter (D_o) of 120 mm. The uniform level of interface pressure (p) is $5x10^4$ Nm^{-2}. The Coefficient of friction (μ) is 0.3. Calculate the following,

   i. the Moment of Inertia (I) of the flywheel,

   (02 marks)

   ii. the Axial Force (F) clamping the driving and driven disk,

   (1.5 marks)

   iii. the Torque (T) required to produce slipping of the clutch,

   (02 marks)

   iv. the Angular Acceleration (α) of the flywheel,

   (1.5 marks)

   v. the Time required for the flywheel to attain full speed,

   (2.5 marks)

vi. the Angular Displacement (θ) of the clutch,

(1.5 marks)

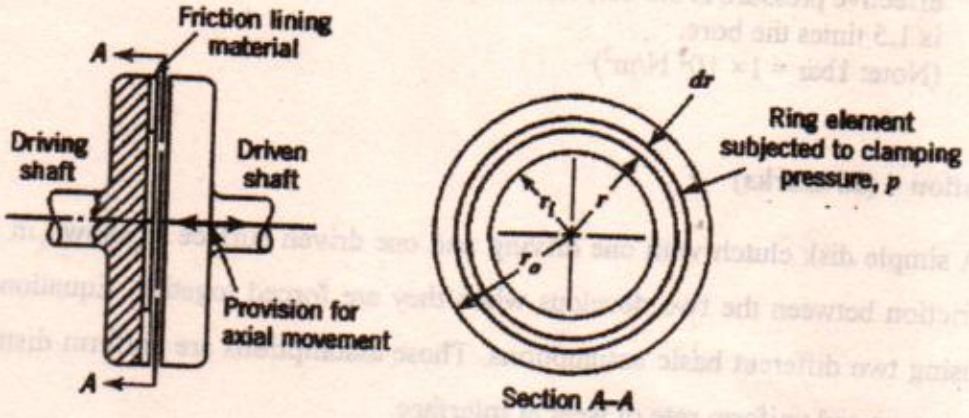

Figure Q4: Front view and plane view of Section A-A of disc clutch.

Question 5 (25 marks)

1. An old vehicle uses external short-shoe drum brakes as brake mechanism. Schematic diagram of short-shoe drum brake system is shown as Figure Q5. Brake design value of friction coefficient (μ) = 0.2. Dimensions are b = 100 mm, r = 250 mm, c = 150 mm, a = 20 mm. The drum is rotating to clockwise direction and brake actuating force (F) is 200 N.

a) Draw the two free body diagrams for shoe with lever and Drum. (Mark all the forces acting on it)

(08 marks)

b) Calculate the Normal Force (N) acting on shoe,

(04 marks)

c) Calculate the **Brake Torque (T),**

(04 marks)

d) Determine magnitude and direction of the Resultant Reaction (O_R) on point due brake actuating force,

(06 marks)

e) If drum rotation direction is counter-clock-wise, draw the free body diagram of shoe with lever and calculate torque to brake self-de-energizing.

(03 marks)

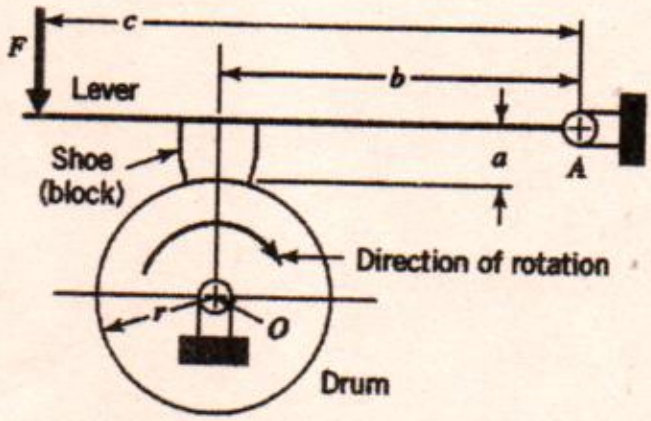

Figure Q5: Brake assembly of external short-shoe drum brakes

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