Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Even) Examination May-2019

AU3CO10 Automotive Transmission

Programme: B.Tech. Branch/Specialisation: AU

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. A clutch is usually designed to transmit maximum torque which is: **1**

(a) Equal to the maximum engine torque.
(b) 80 percent of the maximum engine torque.
(c) 150 percent of the maximum engine torque.
(d) None of these

ii. The clutch is located between the transmission and the: **1**

(a) Engine (b) Rear axle
(c) Differential (d) Propeller shaft

iii. In a simple planetary gear set, the output member to increase torque is always the **1**

(a) Sun gear (b) Planet carrier
(c) Ring gear (d) None of these

iv. The purpose of transmission in an automobile is: **1**

(a) To vary the speed of the automobile
(b) To vary the torque at the road wheels
(c) To vary the power of the automobile
(d) None of these

v. The function of field regulator in a DC compound motor is to **1**

(a) Control field current.
(b) Limit the armature current.
(c) Vary the armature resistance.
(d) None of these

P.T.O.

vi. Ward-Leonard system for controlling the speed of a DC motor is used where **1**
(a) The accuracy in speed control is required.
(b) The speed in both the direction is required.
(c) Very fine speed control over the whole range from zero to normal speed is required.
(d) All of these

vii. The component of torque converter that allows the multiplication of torque is the: **1**
(a) Turbine (b) Impeller (c) Pump (d) Stator

viii. In a torque converter maximum torque multiplication occurs at: **1**
(a) Stop (b) Low speed
(c) Medium speed. (d) High speed

ix. An automatic transmission in a rear-wheel-drive vehicle does not go into either drive or reverse. Which of the following is the most likely cause? **1**
(a) A defective vacuum modulator.
(b) A defective governor.
(c) A defective pump.
(d) An incorrectly adjusted throttle valve cable.

x. An automatic transmission is not shifting correctly. A check of the fluid level indicates that the fluid is full of air bubbles. Which of the following could be the likely cause? **1**
(a) The transmission is over-filled.
(b) The transmission level is low.
(c) The vent is restricted.
(d) The fluid is contaminated with water.

Q.2 i. State the properties of good clutch lining. **2**

ii. With the aid of neat sketches describe the constructional features of diaphragm type clutch. Discuss the advantages and disadvantages of the diaphragm clutch over clutch employing helical springs. **8**

OR iii. Determine the size of the clutch plate suitable for an Ambassador car employing a single plate type of friction clutch and developing 37.5 kW at 4200 r.p.m. The inside diameter of clutch plate is 0.6 times its **8**

outer diameter and it is to be ensured that even after a loss of 30% of the engine torque due to wear of clutch facing, the clutch does not slip. The intensity of pressure on the facing is not to exceed 70 kPa. Assume $\mu = 0.3$.

Q.3 i. Why is helical gear preferred in transmission? **2**

ii. A sliding mesh type of gear box with forward speeds only is to be designed. The gear box should have the following gear ratios available approximately: 1.0, 1.5, 2.5 and 3.9. The centre distance between the lay shaft and the main shaft is 78 mm and the smallest gear is to have at least 16 teeth with a diametral pitch of 3.25 mm. Calculate the number of teeth of the various gears and the exact gear ratios thus available. **8**

OR iii. Describe the working of a synchromesh gear box with the help of a neat sketch. What are the merits and demerits of it compared to sliding mesh and constant mesh gear boxes. **8**

Q.4 i. List out the merits and demerits of Hydrostatic drive. **3**

ii. Explain the principle of modified ward Leonard type of control for electric drive in vehicles. **7**

OR iii. Explain the construction and working principle of typical Janny hydrostatic drive. **7**

Q.5 i. What is the need of stator in a torque converter? **2**

ii. Describe with a neat sketch the construction and working of torque converter. **8**

OR iii. What is fluid coupling? Draw and explain its performance curves. **8**

Q.6 Attempt any two:

i. Explain Chevrolet "Turbo glide" Transmission system using suitable schematic diagram. **5**

ii. Explain "ECT-i" Automatic Transmission with Intelligent Electronic controls system. **5**

iii. Draw a schematic diagram of hydraulic control system for automatic transmission system and explain it. **5**

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Marking Scheme
AU3CO10 Automotive Transmission

Q.1 i. A clutch is usually designed to transmit maximum torque which is: **1**
(c) 150 percent of the maximum engine torque.

ii. The clutch is located between the transmission and the: **1**
(a) Engine

iii. In a simple planetary gear set, the output member to increase torque is always the **1**
(b) Planet carrier

iv. The purpose of transmission in an automobile is: **1**
(b) To vary the torque at the road wheels

v. The function of field regulator in a DC compound motor is to **1**
(a) Control field current.

vi. Ward-Leonard system for controlling the speed of a DC motor is used where **1**
(d) All of these

vii. The component of torque converter that allows the multiplication of torque is the: **1**
(d) Stator

viii. In a torque converter maximum torque multiplication occurs at: **1**
(a) Stop

ix. An automatic transmission in a rear-wheel-drive vehicle does not go into either drive or reverse. Which of the following is the most likely cause? **1**
(c) A defective pump.

x. An automatic transmission is not shifting correctly. A check of the fluid level indicates that the fluid is full of air bubbles. Which of the following could be the likely cause? **1**
(a) The transmission is over-filled.

Q.2 i. Any four properties of good clutch lining. (0.5 mark * 4) **2**

ii. Neat sketches of diaphragm type clutch 1 mark **8**
Constructional features of diaphragm type clutch 3 marks
Advantages and disadvantages of the diaphragm clutch over clutch 4 marks

OR iii. Determine the size of the clutch plate **8**

Solution.

Torque developed by the engine $= \frac{\text{Power output (kW)} \times 60000}{2\pi \times \text{(R.P.M.)}}$

$= \frac{375 \times 60{,}000}{2\pi \times 4200} = 85.26 \text{ Nm} = 85260 \text{ Nmm}$ 1 mark

$\therefore$ Design torque, $T = 1.3 \times 85260 = 110830 \text{ Nmm}$ 1 mark

$= 2\mu WR$

Now, $W = 2\pi (pr)(r_o - r_i)$

where, p = intensity of pressure

r_i = inside clutch plate radius $= 0.6\, r_o$

r_o = outer clutch plate radius

$pr = p_{max}\, r_i = .07\, r_i = .07 \times (.6\, r_o) = .042\, r_o$ 1 mark

Substituting the above into Eq. (3.15)

$W = 2\pi (.042\, r_o)(r_o - .6\, r_o) = .0336\, \pi r_o^2$ 1 mark

$R = \frac{r_i + r_o}{2} = \frac{.6\, r_o + r_o}{2} = 0.8\, r_o$ 1 mark

Substituting W,R and μ in Eq. (3.18)

$110830 = 2 \times 0.3 \times (.0336\, \pi r_o^2) \times (.8 r_o) = .0506\, r_o^3$

$r_o^3 = 2{,}187{,}393$

$r_o = 129.8 \text{ mm}$ 1 mark

$\therefore$ Outside diameter $= 2\, r_o = \mathbf{259.6 \text{ mm}}$ 1 mark

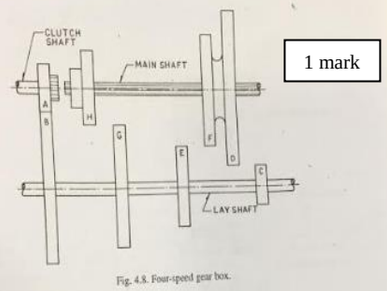
Inside diameter $= 2 \times .6\, r_o = \mathbf{155.7 \text{ mm}}$ 1 mark

Q.3 i. Helical gear preferred in transmission **2**

ii. Calculate the number of teeth of the various gears and the exact gear ratios thus available. **8**

Consider Fig. 4.8. Then if T stands for the number of teeth, N for the speed and G for the gear ratio,

$T_A + T_B = T_C + T_D = T_E + T_F = T_G + T_H = \frac{78 \times 2}{3.25} = 48$ ...(1)



1 mark

Fig. 4.8. Four-speed gear box.

First gear

Gear ratio, $G_1 = \frac{N_A}{N_D} = \frac{T_D}{T_C} \times \frac{T_B}{T_A}$

$\therefore \quad 3.9 = \frac{T_D}{T_C} \times \frac{T_B}{T_A}$ ...(2)

Second gear

$G_2 = \frac{N_A}{N_F} = \frac{T_F}{T_E} \times \frac{T_B}{T_A}$

$\therefore \quad 2.5 = \frac{T_F}{T_E} \times \frac{T_B}{T_A}$ ...(3)

Third Gear

$G_3 = \frac{N_A}{N_H} = \frac{T_H}{T_G} = \frac{T_B}{T_A}$

$\therefore \quad 1.5 = \frac{T_H}{T_G} \times \frac{T_B}{T_A}$ ...(4)

Now smallest gear is to have 16 teeth.

Let $T_A = 16$

1 mark

Then from equation (1)

$T_B = 48 - 16 = 32$ 1 mark

From equation (2)

$3.9 = \frac{T_D}{T_C} \times \frac{32}{16}$

$\therefore \quad \frac{T_D}{T_C} = 1.95$

Substituting in equation (1),

$T_C + 1.95\, T_C = 48$

$\therefore \quad T_C = 16.2$, say **16**

and $T_D = 48 - 16 = 32$ 1 mark

From equation (3),

$2.5 = \frac{T_F}{T_E} \times \frac{32}{16}$

$\therefore \quad \frac{T_F}{T_E} = 1.25$

Substituting in equation (1),

$T_E + 1.25\, T_E = 48$

$\therefore \quad T_E = 21.3$ say **21**

$T_F = 48 - 21 = 27$ 1 mark

From equation (4),

$1.5 = \frac{T_H}{1.6} \times \frac{32}{16}$

$\therefore \quad \frac{T_H}{T_G} = 0.75$

Substituting in equation (1),

$T_G + 0.75\, T_G = 48$

$\therefore \quad T_G = 27.4$ say **27**

$T_H = 48 - 27 = 21$ 1 mark

$\therefore$ Exact gear ratios are :

$G_1 = \frac{32}{16} \times \frac{32}{16} = \mathbf{4.00}$

$G_2 = \frac{27}{21} \times \frac{32}{16} = \mathbf{2.57}$

$G_3 = \frac{21}{27} \times \frac{32}{16} = \mathbf{1.55}$ 2 marks

OR iii. Synchromesh gear box neat sketch 1 mark **8**
Working of a synchromesh gear box 3 marks

		Merits and demerits of synchromesh gear box compared to sliding mesh	2 marks	
		Merits and demerits of synchromesh gear box compared to constant mesh	2 marks	
Q.4	i.	Any three merits of Hydrostatic drive.	1.5 marks	**3**
		Any three demerits of Hydrostatic drive.	1.5 marks	
	ii.	Principle of modified ward Leonard type of control for electric drive in vehicles.		**7**
		Diagram	1 mark	
		Principle	2 marks	
		Description	4 marks	
OR	iii.	Construction and working principle of typical Janny hydrostatic drive.		**7**
		Diagram	2 marks	
		Description	5 marks	
Q.5	i.	Need of stator in a torque converter		**2**
	ii.	Construction and working of torque converter.		**8**
		Diagram	1 mark	
		Description of principle parts / construction	3 marks	
		Working	4 marks	
OR	iii.	Diagram of fluid coupling	1 mark	**8**
		Description of principle parts / construction	2 marks	
		Drawing and description of performance curves.	5 marks	
Q.6		Attempt any two:		
	i.	Chevrolet "Turbo glide" Transmission system		**5**
		Working	3 marks	
		Diagram.	2 marks	
	ii.	"ECT-i" Automatic Transmission with Intelligent Electronic controls system.		**5**
		Working	3 marks	
		Diagram.	2 marks	
	iii.	Hydraulic control system for automatic transmission system		**5**
		Working	3 marks	
		Diagram.	2 marks	

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