

DEPARTMENT OF AGRICULTURAL AND FOOD ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

M.Tech. in Farm Machinery and Power
End- Spring Semester Examination 2009-2010

Sub. No. and Name : AG60004 Tractor Systems Design II
Date of Examination : 22.04.2010 (FN)
No. of students : 16
Special Instructions : **Attempt all questions**

Time: 3 hrs
Max. Marks: 50

Make reasonable assumptions wherever required

1. (a) Explain the advantages and disadvantages of restrained link operation over free link operation for agricultural tractors. (2)
- (b) Compute the weight transfer on rear axle of a 2WD tractor equipped with a Mouldboard plough when used under free link operation and restrained link operation. For free link operation, $P_v = 8.5$ kN at a slope of 12° and for restrained link operation, $P_v = 11.5$ kN at a slope of 20° . The wheel reaction against the rear wheels, shifted ahead of the centre of wheel axle, intersects with the line of pull at a point which is at a distance y from the ground contact point in the vertical plane. The distance y is 130 mm for free link operation and 65 mm for restrained link operation. The effective wheelbase of tractor is 1.80 m. Weight of the implement and R_v for the implement are the same in both the cases. (6)
2. Explain with a hydraulic circuit the working of automatic implement draft control system used in MF-1035 tractor. What type of overload release mechanism is used in this tractor and how it works? (8)
3. Determine the following design parameters of a new hydraulic brake for a 2WD tractor weighing 2100 kg. The tractor is equipped with 13.6-28 bias-ply tyres on rear axle. The size of the brake drum used is 35 cm. Assume coefficient of friction between brake shoe and drum=0.4. Use design fluid pressure as 100 bar. (8)
 - (a) Braking torque required for each wheel
 - (b) Size of the master cylinder
 - (c) Size of the wheel cylinder
 - (d) Total mechanical and hydraulic advantage
4. A tractor is provided with a hydrostatic steering system having cross connected cylinders.
 - (a) Draw a suitable hydraulic circuit for the system
 - (b) How do you calculate the engine power consumed by the system while taking a turn under normal operating conditions?
 - (c) How do you evaluate the performance of such a system for transport work? (8)

.....contd 2/

5. A hydrostatic transmission operating at 70 bars pressure, has the following characteristics.

Pump	Motor
$V_D = 82 \text{ cm}^3$	$V_D = ?$
$\eta_v = 82 \%$	$\eta_v = 92 \%$
$\eta_m = 88 \%$	$\eta_m = 90 \%$
$N = 500 \text{ rpm}$	$N = 400 \text{ rpm}$

Determine (a) Displacement of the motor
(b) Motor output torque (8)

6. (a) Prove that for the two cylinders to be synchronized, the piston area of cylinder 2 must equal the difference between the areas of the piston and rod for cylinder 1. (2)
- (b) A 100 kN press has the tools weighing 5 kN and is operated by a hydraulic circuit having a counterbalance valve. If the cylinder bore diameter is 80 mm and cylinder rod diameter is 60 mm, suggest the required minimum pressure setting for the counter balance valve and the pressure relief valve. (3)
- (c) A 3- stage displacement type telescopic cylinder is used to tilt the body of a trailer. With a schematic diagram, explain its working during extend and retract strokes. (3)
- (d) Calculate the required dynamic weight on rear axle of a 2WD tractor if axle Power = 20 kW, theoretical wheel velocity = 5 km/h, and desired GTR= 0.54. (2)

.....