

**AGRICULTURAL AND FOOD ENGINEERING DEPARTMENT  
IIT KHARAGPUR**

**End-Spring Semester Examination 2010-2011  
3<sup>rd</sup> Yr. B.Tech. (Hons.)**

**Date of Exam:**

**Max. Marks: 50**

**Subject No.: AG31002**

**Time: 3 hrs**

**Subject Name: Tractor & Power Systems**

**No. of Students: 34**

**Instructions: Answer all questions. Answer must be brief and to the point. Marks for the questions are indicated in the right hand margin.**

1(a). In a given planetary gear drive, the ring gear has 80 teeth and is held stationary. Power comes into the drive on the sun gear, which has 33 teeth and rotates clockwise at 120 revolutions per minute. Power comes out of the gear set on the planet carrier. Determine how fast does the planet carrier rotate and its direction of rotation. (5)

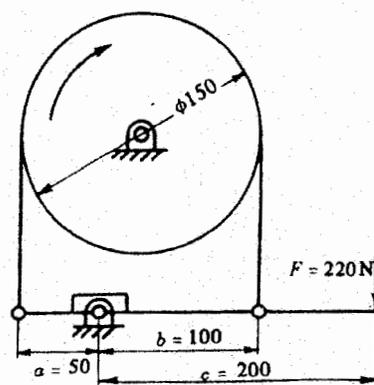
(b). Two bevel gears 'A' and 'B' having 40 teeth and 30 teeth respectively are rigidly mounted on two co-axial shafts X and Y. A bevel gear C with 50 teeth meshes with A and B and rotates freely on one end of an arm. At the other end of the arm a sleeve is welded and the sleeve is riding freely loose on the axes of the shafts X and Y. Sketch the arrangement. If the shaft X rotates at 150rev/min clockwise and arm rotates at 100rev/min anticlockwise find the speed of the shaft Y. (5+4)

(c). Write short notes on the following: (6)

- (i) Weight transfer
- (ii) Pressure relief valve
- (iii) Synchronizing clutch

2. A multiple disk clutch has six pairs of contact surfaces of alternate steel and asbestos lined steel. The outside and inside diameters of the contact surfaces are 250mm and 180mm respectively. How much power can be transmitted at 600rev/min if the co-efficient of friction is 0.2 and the axial force is 400N? (6)

3. A differential band brake has a force of 220N applied at the end of the lever as shown in Fig.1. The co-efficient of friction is 0.4. (i) If a clockwise torque of 450Nm is applied to the drum, determine the maximum and minimum force in the band. (ii) What is the maximum torque that the brake may sustain for counterclockwise rotation of the drum? (6)



dimensions of a, b,  
and c are in mm

**Fig.1**

4. A 5-speed sliding gear box of a motor car is required to give speed ratios from the driving shaft to the driven shaft of  $1/5$ ,  $1/4$ ,  $1/3$ ,  $1/2$ , and 1 in the first, second, third, fourth and top gears respectively. The pitch of the gears in module is 3.75mm and maximum torque to be transmitted through the gear box is 145Nm at 1400rev/min of the engine. Find suitable number of teeth on various gears if the pressure angle of the gear tooth is  $22^\circ$ . (5)
5. A rear wheel drive tractor with a total weight of 52.3kN has a wheel base of 2662mm, and the centre of gravity is 711mm ahead of the rear axle centerline. The tractor is pulling a level drawbar pull of 25.8kN on concrete, and the drawbar height is 485mm. The actual travel speed is 8.31kmph and the no-load travel speed is 8.69kmph. The axle power is 66 kW. Calculate, (a) the travel reduction, (b) dynamic load on the rear axle and (c) tractive efficiency. (6)
- 6(a). The following specification for a certain gear pump were listed in a catalog:  
 displacement =  $29.5\text{cm}^3/\text{rev}$ ;  
 rated speed = 2500rev/min;  
 rated pressure = 20.7MPa,  
 rated delivery = 68.13L/min;  
 power input = 28.35kW at rated speed and delivery.  
 Calculate the volumetric efficiency of the pump and the actual torque developed. (4)
- (b). A double acting hydraulic cylinder with a piston diameter of 76.20mm, rod diameter of 25.4mm has a stroke length of 203.2mm and is operating at a maximum pressure of 17.2MPa. Compute the maximum safe load the cylinder can move while extending and also while retracting. (3)

OR

An engine manufacturer wants to provide four engine models from one basic design of a 6-cylinder, 7.636L diesel engine that is to run at a rated speed of 2200rev/min. The desired power level of the four engines are to increase in approximately 15kW increments from a base level of 75kW for the naturally aspirated (NA) version of the engine. How much turbocharging and intercooling be used to accomplish the objective? The intercooler is to use the engine coolant as the secondary fluid, and the thermostat provides a coolant temperature of  $90^\circ\text{C}$ . Tests have shown that the NA engine can achieve brake specific fuel consumption (BSFC) of 0.3kg/kW.h. Make justified assumptions. (7)

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