

**B.Tech Odd Semester (CBCS) Exam.,
December—2016**

AGRICULTURAL ENGINEERING

(7th Semester)

Course No. : AE-706

(Elective—II : Advanced Farm Power)

Full Marks : 75

Pass Marks : 30

Time : 3 hours

- Note :
1. Attempt **one** question from each Unit.
 2. Begin each answer in a new page.
 3. Answer parts of a question at a place.
 4. Assume reasonable data wherever required.
 5. The figures in the margin indicate full marks for the questions.

UNIT—1

1. (a) Explain the basic working principles of hydraulic system of tractor. Distinguish between—
 - (i) motor and pump;

- (ii) positive displacement pump and non-positive displacement pump;
- (iii) pressure relief valve and check valve.

9

- (b) A pump has a displacement volume of $120 \text{ cm}^3/\text{rev}$. It delivers $0.0015 \text{ m}^3/\text{s}$ at 1440 r.p.m. and 60 bar. If the prime mover input torque is 130 Nm, what is the overall efficiency of the pump? What is the theoretical torque required to operate the pump?

6

2. (a) Explain the working of hydrostatic transmission. How does it meet the requirements of a gearbox of a vehicle?

9

- (b) A hydraulic cylinder has a bore of 200 mm and a piston rod diameter of 140 mm. For an extend speed of 5 m/min, calculate—

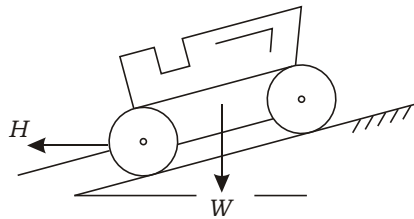
- (i) the supply flow rate;
- (ii) the flow rate from the annulus side on extend;
- (iii) the retract speed if the same flow rate as in the above (i) is used to retract the cylinder;
- (iv) the flow rate from the full bore end on retract.

6

(3)

UNIT—2

3. (a) Draw a neat sketch of 3-point hitch system of tractor. Distinguish between draft control mode and position control mode of implement control by the tractor. 9
- (b) Explain virtual hitch point and line of pull. Show that the resultant soil reaction force does not pass through virtual hitch point. 6
4. (a) Derive the expression for the weight transfer from the front axle and the implement for a 2 WD tractor on a slope with angle of slope = θ and applying a horizontal pull. A crawler tractor is standing on a slope as shown in the figure below :



The following data apply :

- Track-soil contact length = 1.2 m
Track width (total for two) = 0.6 m
Tractor mass $W = 2.4$ tonnes

(4)

Soil cohesion = 15 kPa

Soil angle of internal friction = 30°

Angle of slope = 15°

Estimate the tractive effort of the tractor and the gross tractive coefficient. Assume that the normal stress under the track is uniform. 9

- (b) A tractor was tested on a firm surface and gave the following data :

Rear wheel weight = 3900 kg

Engine power = 62.1 kW

Drawbar pull = 26.2 kN

Fuel consumed = 176 g

Distance, no-load = 55.8 m

Time = 25.8 s

Distance, load = 46.2 m

Determine the wheel slip, travel speed, drawbar power, tractive efficiency, fuel consumption and specific fuel consumption. 6

UNIT—3

5. (a) Explain the procedure to find the centre of gravity of a 2 WD tractor. 6
- (b) On a level ground, 2 WD tractor weighing 18 kN has the 2/3rd of the static weight supported by the rear wheel axle. Wheel base of the tractor

is 2100 mm. The tyre on the front wheel axle is 6 × 12—6 PR and tyre on the rear wheel axle is 13·6 × 28—6 PR. When the front wheel axle was raised by 0·9 m, the weight on the rear wheel axle got increased by 1·5 kN. Calculate the position of CG of the tractor. 9

6. (a) Explain the working of hydraulic steering system employed in a high horsepower crawler tractor. 9
- (b) What is power steering? Explain its working with a neat sketch. 6

UNIT—4

7. (a) What is traction? Explain Coulomb's theory for the tractive force. Describe Bekker's theory for the rolling resistance of the tracks of the crawler tractor. 9
- (b) Distinguish among (i) towed wheel, (ii) self-propelled wheel, (iii) braked wheel and (iv) driving wheel. 6
8. (a) Explain Brixius model for the prediction of traction of a wheeled tractor. 6
- (b) State Wismer-Luth theory of traction. Explain the variation in COT and tractive efficiency with slip. 9

UNIT—5

9. (a) Explain the Ackerman steering system. Describe the stability of tractor while negotiating a turn. Determine the maximum speed of turning by a 2 WD tractor while taking a turn along the radius of 5 m. The tractor has the wheel tread of 1·5 m and wheel base of 2100 mm. The CG of tractor is located at a height of 90 cm from the ground level. 9
- (b) Explain the importance of the following in the tractor steering system : 6
- (i) Camber
(ii) Kingpin inclination
(iii) Toe-in
(iv) Castor
(v) Toe-out
10. Write short notes on the following : 15
- (a) Recent trends in tractor system design
(b) Ergonomics
(c) Noise and vibration effects on tractor operators
