Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VII EXAMINATION – WINTER 2015**

**Subject Code: 170202** **Date:07/12/2015**

**Subject Name: Automobile System Design**

**Time: 10:30am to 1:00pm** **Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** An automobile engine has an output of 80 kW at 3000 rpm. The mean diameter of the clutch is 200 mm with a permissible pressure of 0.2 $N/mm^2$. Friction lining is of asbestos with $\mu = 0.22$. What should be the inner diameter of the disc? Take both sides of the plate with friction lining as effective. There are 8 springs and axial deflection in spring is limited to 10 mm. design the spring. Given, $G = 80\ kN/mm^2$. Spring index may be taken as 6. **08**

**(b)** Explain anti-lock braking system. **06**

**Q.2** **(a)** A 4-shoe centrifugal clutch is used to transmit 40 kW at 1400 rpm. The engagement is at 80% of the full speed. Inner diameter of the drum is 320 mm and CG of each shoe is radially at a distance of 130 mm from axis. Coefficient of friction between friction lining and drum is 0.22. Determine mass of each shoe. When the shoe is engaged with the drum, normal pressure between friction lining and drum is 0.1 MPa. If the arc of contact for each friction lining is 60°, determine length and breadth of friction lining. **08**

**(b)** Write short note on universal joint and slip joint. **06**

**OR**

**(b)** Write short note on chassis dynamometer. **06**

**Q.3** **(a)** A rail wagon of mass 20 tonnes is moving with a velocity of 2 m/s. It is brought to rest by two buffers with springs of 300 mm diameter. The maximum deflection of springs is 250 mm. The allowable shear stress in the spring material is 600 MPa. Design the spring and calculate: **08**

(i) diameter of the spring wire
(ii) number of turns of the spring coil
(iii) free length of spring
(iv) pitch of the coil

**(b)** Explain working of vacuum servo assisted brake. **06**

**OR**

**Q.3** **(a)** A four wheeled automobile car has a total mass of 1000 kg. The moment of inertia of each wheel about a transverse axis through its centre of gravity is 0.5 $kg\text{-}m^2$. The rolling radius of the wheel is 0.35 m. The rotating and reciprocating parts of the engine and the transmission system are equivalent to a moment of inertia of 2.5 $kg\text{-}m^2$, which rotates at five times the road-wheel speed. The car is traveling at a speed of 100 km/h on a plane road. When the brakes are applied, the car decelerates at 0.5 g. There are brakes on all four wheels. Calculate: **08**

(i) The energy absorbed by each brake

(ii) The torque capacity of each brake

**(b)** Explain the Ackermann principle as applied to steering. **06**

**Q.4** **(a)** A propeller shaft is required to transmit 45 kW at 500 rpm. It is a hollow shaft, having an inside diameter 0.6 times of outside diameter. It is made of plain carbon steel and the permissible shear stress is 84 $N/mm^2$. Calculate the inside and outside diameters of the shaft. **08**

**(b)** With the help of sketch describe the construction of leaf spring and explain nipping of spring. **06**

**OR**

**Q.4** **(a)** A motor car has a wheel-base of 2.743 m and pivot centre of 1.065 m. the front and rear wheel track is 1.217 m. Calculate the correct angle of outside lock and turning circle radius of the outer front and inner wheels when the angle of inside lock is 40°. **08**

If the gear ratio of a steering box is 14:1 and driver applies a force of 25 N with each hand on the steering wheel of 0.38 m diameter, the torque transmitted to the drop-arm shaft is 110 Nm, determine the percentages efficiency of the steering mechanism.

**(b)** Write design considerations for friction clutches. **06**

**Q.5** **(a)** Design a suitable I-section for the front axle. Assuming the following data: **08**

Total weight of car = 13734 N
Load taken by front axle = 6376 N
Wheel track = 1400 mm
Distance between the centers of the spring pads = 700 mm
Width of flange and thickness are 0.6 and 0.2 of the overall depth of the section. Thickness of the web = 0.25 of width of flange
Working stress = 90 $N/mm^2$.

**(b)** Write short note on anti-roll bar. **06**

**OR**

**Q.5** **(a)** Explain Johnson's method of optimum design with suitable example. **08**

**(b)** Explain brake efficiency and brake fade. **06**

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