Name: **Enrolment No:**	**UPES SAP ID:**

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May, 2021

Course: Automotive Sub-System Design — **Semester: V**
Program: B.Tech – ADE — **Time: 3 hours**
Course Code: MEAD3011 — **Max. Marks: 100**
No. of Pages: 02

Note:

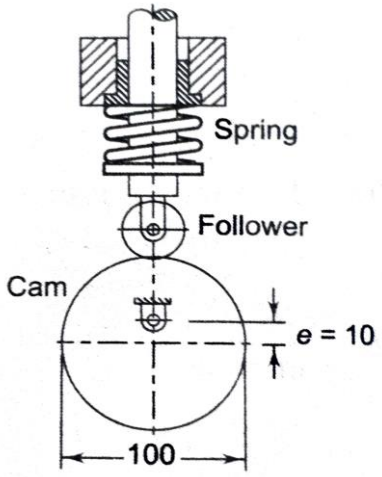
1. The paper consists of 3 sections A, B and C.
2. For Section A, type your answers in the browser directly
3. For Sections B and C, scan and upload your answers.
4. In Section C, Q12 has internal choice.

Section A

Q1.	Discuss the importance of wheelbase in vehicle's ride and handling properties.	**5**	**CO1**
Q2.	Explain the reason for using a special extreme pressure lubricating oil with hypoid gear.	**5**	**CO6**
Q3.	Explain the necessity for pre-loading the pinion ball-race bearing during assembly.	**5**	**CO4**
Q4.	Explain why the clutches are generally designed on the basis of uniform wear theory.	**5**	**CO2**
Q5.	Explain surge in spring.	**5**	**CO5**
Q6.	Explain roll centre and body roll axis with their importance.	**5**	**CO1**

Section B

Q7.	A four-speed sliding gear box of an automobile is to be designed to give approximate speed ratios of 4, 2.4, 1.4 and 1 for the first, second, third and top gears respectively. The input and the output shafts have the same alignment. Horizontal central distance between them and the lay shaft is 98 mm. The teeth have a module of 4 mm. No wheel has less than 16 teeth. Determine suitable number of teeth on each wheel and actual speed ratios attained.	**10**	**CO6**
Q8	Design a suitable I cross section of front axle based on following data: The total weight of vehicle is 2700 kgf The total load taken by front axle is 52% Wheel radius is 280 cm The distance between the center of the spring pad and spindle axis is 132 cm. Assume a working stress of 915 kgf/cm^2	**10**	**CO4**
Q9	The distance between the king-pins of car is 1.2 m. The track arms are 0.2 m long and the length of the track rod is 1 m. For a track of 1.5 m and a wheel base of 3.2 m, determine the radius of curvature of the path followed by the near-side front wheel at which correct steering is obtained when the car is turning to the right.	**10**	**CO3**
Q10	A Hooke's joint connects two shafts whose axes intersect at 150°. The driving shaft rotates uniformly at 120 rpm. The driven shaft operates against a steady torque of 150 Nm and carries a flywheel whose mass is 45 kg and radius of gyration 150 mm. Determine the maximum torque which will be exerted by the driving shaft.	**10**	**CO6**

Q11	A multi-plate clutch transmitting 52 kW of power has a speed of 1500 rpm. The outer radius of friction surface is 120 mm and it is 1.25 times the inner radius. The coefficient of friction between the friction surfaces is 0.15. The axial intensity of pressure is limited to 150 kN/m^2. Determine the number of plates required to transmit the required power.	**10**	**CO2**
	Section C		
Q12	An automotive single plate clutch consists of two pairs of friction surfaces, one between the friction lining and the pressure plate and the other between the friction lining and the flywheel. Eight identical helical compression springs, arranges in parallel, provide the required axial thrust on the friction surface. The total spring force exerted by all springs is 2400 N and the corresponding deflection of each spring is approximately 15 mm. The spring index can be taken as 8. The springs are made of patented and cold-drawn steel wire of Grade-1 (G = 81370 N/mm^2). The constants A and m can be taken as 1753 and 0.182 respectively. The permissible shear stress for the spring wire can be taken as 30% of the ultimate tensile strength. Design the springs and determine: (i) Wire diameter; (ii) Mean coil diameter; (iii) Number of active coils; (iv) Total number of coils; (v) Solid length; (vi) Free length; (vii) Pitch of the coil; (viii) Required stiffness of the spring; (ix) Actual stiffness of the spring. **OR** An eccentric cam, 100 mm in diameter, rotates with an eccentricity of 10 mm as shown in figure below. The roller follower is held against the cam by means of a helical compression spring. The force between the cam and the follower varies from 100 N at lowest position to 350 N at the highest position of the follower. The permissible stress in the spring wire is recommended as 30% of the ultimate tensile strength. Design the spring from static considerations and determine the factor of safety against fluctuating stresses. Neglect the effect of inertia forces.  	**20**	**CO5**