MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)

END SEMESTER ONLINE PROCTORED EXAMINATIONS, JAN/FEB 2021

SUBJECT: DESIGN OF MACHINE ELEMENTS [AAE 3173]

REVISED CREDIT SYSTEM

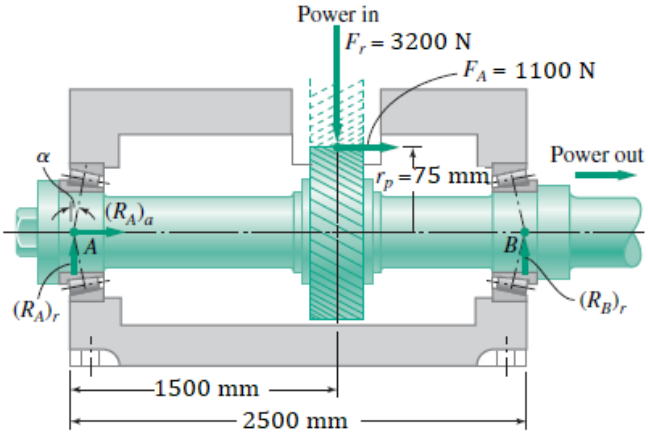
(02/02/2021)

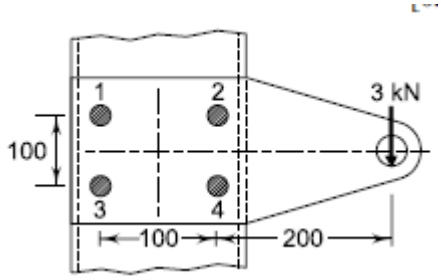
Duration: 3 Hours Max. Marks: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data if any, may be suitably be assumed.
- Use of supplied data sheet is permitted

Q. No	Question	Max. Marks	CO	BT Level
1	It is required to design a helical compression spring subjected to a maximum force of 7.5 kN. The mean coil diameter should be 150 mm from space consideration. The spring rate is 75 N/mm. The spring is made of oil-hardened and tempered steel wire with ultimate tensile strength of 1250 N/mm2. The permissible shear stress for the spring wire is 30% of the ultimate tensile strength (G = 81 370 N/mm2). Calculate (i) wire diameter; and (ii) number of active coils	(04)	CO3	L3
2	The following data is given for a pair of spur gears with 20° full-depth involute teeth: number of teeth on pinion = 24, number of teeth on gear = 56, speed of pinion = 1200 rpm, module = 3 mm, service factor = 1.5, face width = 30 mm. Both gears are made of steel with an ultimate tensile strength of. 600 N/mm^2. Using the velocity factor to account for the dynamic load, calculate (i) beam strength; (ii) velocity factor; and (iii) rated power that the gears can transmit without bending failure, if the factor of safety is 1.5.	(06)	CO4	L3
3	The force acting on a bolt consists of two components—an axial pull of 12 kN and a transverse shear force of 6 kN. The bolt is made of steel FeE 310 (Syt = 310 N/mm2) and the factor of safety is 2.5. Determine the diameter of the bolt using the maximum shear stress theory of failure.	(04)	CO2	L2

4	A pair of worm and worm wheel is designated as 2/52/10/4 10 kW power at 720 rpm is supplied to the worm shaft. The coeffi cient of friction is 0.04 and the pressure angle is 20°. Calculate the tangential, axial and radial components of the resultant gear tooth force acting on the worm wheel.	(06)	CO3	L3
5	A pair of continuously lubricated and carefully cut helical gears is to transmit 15 kW at 5000 rpm of the pinion. Both the gears are made of cast steel CS-840 (untreated). The centre distance is approximately 200 mm. The velocity ratio is 4:1. The teeth are of 20° full depth involute profile. The helix angle is 25°. Take face width as 15 times the normal module. The gears are subjected to medium shock with 10hrs/day of service. Factor of safety is 1.5. Using the velocity factor to account for the dynamic load, Design the gears based on strength. Also calculate wear load for given load stress factor K=0.420.	(05)	CO4	L4
6	Fig shows a shaft mounted with a helical gear between two bearings at A and B. The radial and thrust load acting on the gear are 3200N and 1100N respectively. Pitch circle radius of the gear is 75mm. It is assumed that, thrust load is taken by bearing A only. The shaft runs at 350rpm for 8 hrs in a day and 5 days in a week. The expected life of the bearing is for 3 years. If the minimum diameter of the shaft is 35mm, select a suitable tapered roller bearing at locations A and B 	(06)	CO5	L3
7	Why are riveted joints replaced by welded joints?	(02)	CO1	L1
8	What are the factors affecting the factor of safety in design?	(02)	C12	L1
9	A steel plate subjected to a force of 3 kN and fixed to a vertical channel by means of four identical bolts is shown in Fig. The bolts are made of plain carbon	(05)	CO2	L2

	steel 45C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 2. Determine the diameter of the shank. 			
10	What is bearing modulus as applied to the journal bearing? Explain	(02)	CO1	L1
11	A ball bearing with a dynamic load capacity of 22.8 kN is subjected to a radial load of 10 kN. Calculate (i) the expected life in million revolutions that 90% of the bearings will reach and (ii) the corresponding life in hours, if the shaft is rotating at 1450 rpm.	(03)	CO5	L2
12	A full journal bearing 80 mm diameter and 140 mm long has a bearing pressure of 2 MPa. The speed of the shaft is 450 rpm. The bearing is operating with SAE 40 oil at 68 ºC in still air. The ambient temperature is 30ºC. The diametral clearance is 0.08 mm. Determine the coefficient of friction, minimum film thickness heat generated and oil flow rate. Assume viscosity of the oil to be 25cP.	(05)	CO5	L4