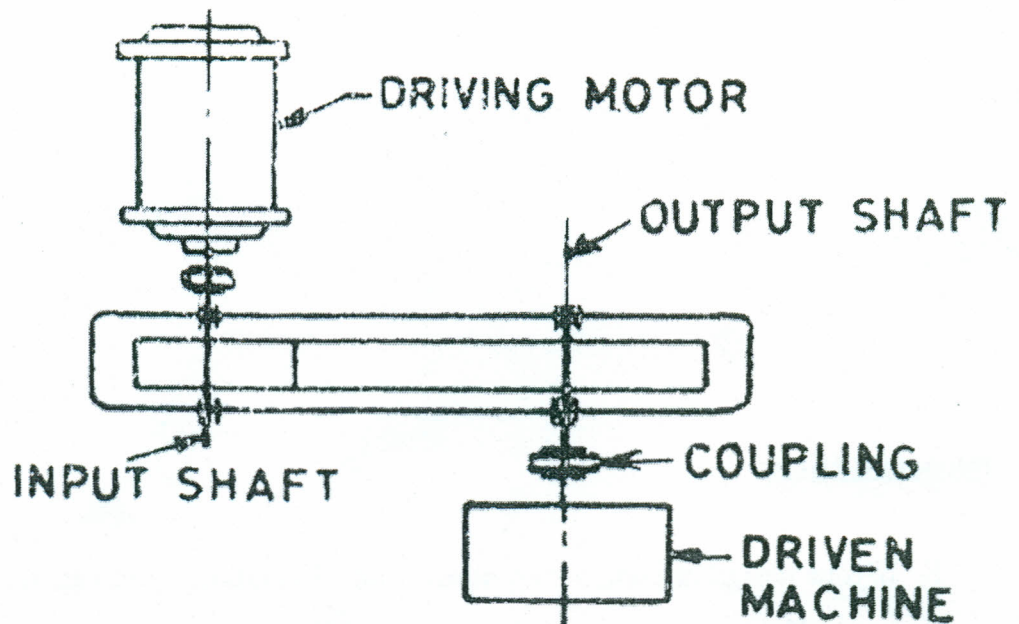




(Open Book Exam)

A machine which runs continuously under constant load consumes **15 kW** of power and is run by an electric motor whose speed is **1200 rpm**. It is required that a spur-gear speed-reducer of one stage be placed between the machine and motor so that the speed is reduced by a factor of **6** (see figure below).

- 1- Design the spur gears.
- 2- Design the output shaft assuming that the distance between the two bearings is 120 mm and the gear is located midway between the two bearings.
- 3- Select one of the two deep groove ball bearings that support the output shaft from the table below.
- 4- Draw constructional drawing of the output shaft showing the fixation of the gear and the bearings.



d	D	B	C	C ₀	P _u	Ref. Speed	Lim. Speed	Mass	Designation	k _r	f ₀
mm	mm	mm	kN	kN	kN	r/min	r/min	kg			
20	72	19	30,7	15	0,64	24000	15000	0,40	6404	0.035	11
25	80	21	35,8	19,3	0,815	20000	13000	0,53	6405	0.035	12
28	58	16	16,8	9,5	0,405	26000	16000	0,18	62/28	0.025	14
30	42	7	4,49	2,9	0,146	32000	20000	0,027	61806	0.015	14
35	100	25	55,3	31	1,29	16000	10000	0,95	6407	0.035	12
40	110	27	63,7	36,5	1,53	14000	9000	1,25	6408	0.035	12
45	120	29	76,1	45	1,9	13000	8500	1,55	6409	0.035	12
50	130	31	87,1	52	2,2	12000	7500	1,90	6410	0.035	12
55	140	33	99,5	62	2,6	11000	7000	2,30	6411	0.035	12
60	150	35	108	69,5	2,9	10000	6300	2,75	6412	0.035	12
65	160	37	119	78	3,15	9500	6000	3,30	6413	0.035	12
70	180	42	143	104	3,9	8500	5300	4,85	6414	0.035	12
75	190	45	153	114	4,15	8000	5000	6,80	6415	0.035	12
80	200	48	163	125	4,5	7500	4800	8,00	6416	0.035	12
85	210	52	174	137	4,75	7000	4500	9,50	6417	0.035	12
90	225	54	186	150	5	6700	4300	11,5	6418	0.035	12
95	200	45	159	118	4,15	7000	4500	5,65	6319-Z *	0.03	13
100	215	47	174	140	4,75	6700	4300	7,00	6320-Z	0.03	13
105	225	49	182	153	5,1	6300	4000	8,25	6321-Z	0.03	13
110	240	50	203	180	5,7	6000	3800	9,55	6322	0.03	13
120	260	55	208	186	5,7	5600	3400	12,5	6324	0.03	14
130	280	58	229	216	6,3	5000	4500	17,5	6326 M	0.03	14
140	300	62	251	245	7,1	4800	4300	22,0	6328 M	0.03	14
150	320	65	276	285	7,8	4300	4000	26,0	6330 M	0.03	14
160	340	68	276	285	7,65	4000	3800	29,0	6332 M	0.03	14

Important Hints:

- 1- If your design at certain step needs a lot of iterations, you can stop it at certain stage. Then, assume reasonable values of the design parameters for this step and use them for designing the next required components.
- 2- Read the question carefully. **Understanding the question is a part of the exam.**