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***B.Tech. Degree VI Semester Regular Examination in
Marine Engineering June 2022***

**19-208-0606 MACHINE DESIGN
(2019 Scheme)**

Time: 3 Hours

Maximum Marks: 60

Course Outcome

On successful completion of the course, the students will be able to:

- CO1: Understand the basic procedure in machine design, the standards used and the design for different load conditions.
 CO2: Gain knowledge regarding fits and tolerances and design of fasteners, welded and revetted Joints.
 CO3: Do the design transmission elements like shaft, belt and chain.
 CO4: Design clutches, bearings and brakes.
 CO5: Design spur gear, bevel gear and helical gear.

Bloom's Taxonomy Levels (BL): L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze,
 L5 – Evaluate, L6 – Create
 PI – Programme Indicators

PART A(Answer *ALL* questions)

(Assume any missing data suitably)

(Use of Standard Machine Design Data Book is permitted)

		(5 × 15 = 75)	Marks	BL	CO	PI
I.	(a) Define any five basic requirements of machine elements.	10	L1	1	3.1.1	
	(b) Draw a flow Chart and explain the basic procedure of machine design.	5	L1	1	3.1.1	
OR						
II.	(a) What is meant by preferred size? Explain.	5	L1	1	3.1.1	
	(b) Explain any three theories of failure.	6	L1	1	3.1.1	
	(c) What is meant by stress Concentration? Illustrate with a sketch, the stress concentration developed due to hole or notch in a plate.	4	L1	1	3.1.1	
III.	(a) Why tolerances are required on mating parts?	5	L3	2	1.3.1	
	(b) Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in crushing.	10	L3	2	1.4.1	
OR						
IV.	Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 rpm. The maximum torque is 20% more than mean torque. The material properties are as follows:	15	L3	2	1.3.1	
	(i) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively					
	(ii) The allowable shear stress for cast iron is 15 MPa					
	(iii) The allowable bearing pressure for rubber bush is 0.8 N/mm ²					
	(iv) The material of the pin is same as that of shaft and key.					

(P.T.O)

BT MRE-VI(R)-06-22-0752

- V. A shaft is supported on bearings A and B, 800 mm between centres. A 20° straight tooth spur gear having 600 mm pitch diameter, is located 200 mm to the right of the left hand bearing A, and a 700 mm diameter pulley is mounted 250 mm towards the left of bearing B. The gear is driven by a pinion with a downward tangential force while the pulley drives a horizontal belt having 180° angle of wrap. The pulley also serves as a flywheel and weighs 2000 N. The maximum belt tension is 3000 N and the tension ratio is 3:1. Determine the maximum bending moment and the necessary shaft diameter if the allowable shear stress of the material is 40 MPa. 15 L3 3 1.4.1
- OR
- VI. (a) Derive an expression for the length of a belt in cross belt drive. 7 L3 3 3.1.1
 (b) An engine running at 150 rpm drives a line shaft by means of belt. The engine pulley is 750 mm diameter and the pulley on the line shaft is 450 mm. A 900 mm diameter pulley on the line shaft drives a 150 mm diameter pulley keyed to a dynamo shaft. Find the speed of dynamo shaft, when 8 L3 3 1.4.1
 (i) there is no slip
 (ii) there is a slip of 2% at each drive.
- VII. A shaft rotating at 1440 rpm is supported by two bearings. The forces acting on each bearing are 6000 N radial load and 3500 N axial thrust. If the shaft diameter is 40 mm and the expected life of the bearing is 500 hrs. 15 L3 4 1.3.1
 (i) select a suitable bearing
 (ii) select a suitable bearing if the required reliability of the bearing is to be 99%.
- OR
- VIII. Explain the working of a single plate clutch with the help of a neat sketch. 15 L3 4 1.3.1
- IX. Design a pair of spur gears to transmit 20 kW of power while operating for 8-10 hrs/day sustaining medium shock, from shaft rotating at 1000 rpm to a parallel shaft which is to rotate at 310 rpm. Assume the number of teeth on pinion to be 31 and 20° full depth involute tooth profile. If load factor $C = 522.464$ N/mm and also for wear load taking load stress factor, $K = 0.279$ N/mm². Suggest suitable hardness. Both the pinion and gears are made of cast steel 0.2% carbon (untreated). 15 L3 5 1.3.1
- OR
- X. In a worm gear speed reducer, the speed reduction is 30:1. Design the worm gear drive from consideration of strength to connect two shafts which are at 275 mm apart and transmits 7.5 kW at a worm speed of 3000 rpm. The worm is made of hardened steel ($\sigma_d = 200$ MPa) and worm wheel of phosphor bronze ($\sigma_d = 84$ MPa). The teeth are 20° stub. 15 L3 5 1.3.1

Blooms's Taxonomy Levels
 L1 – 25%, L3 – 75%.