University Institute of Engineering & Technology

(Recognised Under Section 2(f) and 12B of UGC)

Kurukshetra University, Kurukshetra

THEORY EXAMINATION – JULY, 2021		TIME – 4 Hrs.
B.TECH. (ME)	SEMESTER – VI	M.M. - 75
PAPER – MEC-304	SUBJECT – DESIGN OF MACHINE ELEMENTS	

INSTRUCTIONS TO BE FOLLOWED

- **The candidates will be required to attempt All questions in Part-A and Part-B (Compulsory Sections). Attempt any four questions from Part-C selecting at least one from each unit.**
- **Allotted time for examination is 4 hours that includes time for downloading the question paper, writing answers, scanning of answer sheets and uploading the sheets on the Attendance Sheet Cum Answer Sheet Uploading google form. The link will be closed after the stipulated time.**
- **The PDF files should be saved as Roll No. and Subject Code.**
- **Maximum Page Limit should be 36 (Thirty Six) for attempting the question paper on A4 sheets which could be downloaded and printed from the sample sheets given in the UIET Website.**
- **Over-attemptation should be avoided.**
- **Handwriting should be neat and clean and diagrams should be clear and contrasted.**
- **The candidate should not write their Mobile No. otherwise Unfair Means Case will be made.**
- **While attempting the paper, the candidate will use blue/black pen only.**
- **Before attempting the paper, the candidate will ensure that he/she has downloaded the correct question paper. No complaint for attempting wrong question paper by the candidate will be entertained.**
- **Candidate must ensure that he/she has put his/her signature on each page of the answer sheet used by him/her. Answer sheet without the signature of the candidate will not be evaluated.**
- **Attempt parts A, B & C separately. Do not inter-mix them. Write neatly & mention the question number clearly.**

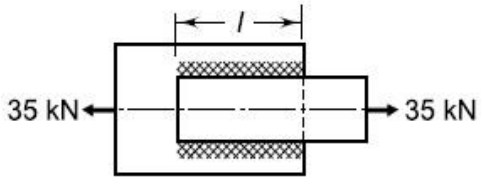
PART-A (15 Marks)

Note: A machine design data book by PSG/Mahadevan/Bhandari may be allowed in the examination.

Q. No. – 1 Answer the following questions carrying one mark each. 15x1=15

(i)	What are the steps involved in design of a machine element?
(ii)	How many basic series are used? How will you denote them?
(iii)	What is grey cast iron? How will you designate grey cast iron?
(iv)	What is X20Cr18Ni2 designation of steel?
(v)	What are the advantages of leaf spring over helical spring?
(vi)	What do you understand by surge in springs?
(vii)	Why the design of clutches are based on uniform wear theory?
(viii)	How the cone clutch have more torque transmitting capacity than the single plate clutch?
(ix)	Define attitude angle.
(x)	What does 51206 bearing no. indicates?
(xi)	What do you understand by L_{10} life?
(xii)	What are the materials used in clutches and brake linings and why?
(xiii)	What do you understand by torsional rigidity and lateral rigidity?
(xiv)	What are the possible reasons of bearings failure?
(xv)	What are partial and full journal bearings?

PART-B (20 Marks)

	UNIT-I	
2	It is required to standardise 11 speeds from 72 to 720 rpm for a machine tool. Specify the speeds.	**5**
	UNIT-II	
3	Two plates are joined together by means of fillet welds as shown in Fig. 1. The leg dimension of the welds is 10 mm and the permissible shear stress at the throat cross-section is 75 N/mm^2. Determine the length of each weld, if 15 mm weld length is required for starting and stopping of the weld run.  Fig.1	**5**

	UNIT-III	
4	It is required to design a square key for fixing a pulley on the shaft, which is 50 mm in diameter. The pulley transmits 10 kW power at 200 rpm to the shaft. The key is made of steel 45C8 (S_{yt} = S_{yc} = 380 N/mm^2) and the factor of safety is 3. Determine the dimensions of the key. Assume (S_{sy} = 0.577S_{yt})	**5**
	UNIT-IV	
5	A single-row deep groove ball bearing No. 6002 is subjected to an axial thrust of 1000 N and a radial load of 2200 N. Find the expected life that 50% of the bearings will complete under this condition.	**5**

PART-C (40 Marks)

	UNIT-I	
6	Explain the Modified Goodman diagram for bending stresses and torsional shear stresses.	**10**
7	A bar of steel has an ultimate tensile strength of 700 MPa, a yield point stress of 400 MPa and fully corrected endurance limit (S_e) of 220 MPa. The bar is subjected to a mean bending stress of 60 MPa and stress amplitude of 80 MPa. Superimposed on it is a mean torsional stress and torsional stress amplitude of 70 and 35 MPa respectively. Find the factor of safety.	**10**
	UNIT-II	
8	A pressure vessel of the boiler consists of cylindrical shell of 0.8 m inner diameter. It is subjected to internal steam pressure of 2 MPa. Triple-riveted double-strap longitudinal butt joint is used to make the shell. The straps are of unequal width. The pitch of the rivets in outer row is twice of the pitch of rivets in middle and inner rows. A zig-zag pattern is used for arrangement of rivets. The efficiency of the joint should be at least 80%. The corrosion allowance is 2 mm. The permissible stresses for rivets and shell in tension, shear and compression are 80, 60 and 120 N/mm^2 respectively. Calculate: (i) thickness of the shell; (ii) diameter of the rivets; (iii) pitch of the rivets in outer row; (iv) distance between outer and middle rows; (v) distance between middle and inner rows; (vi) thickness of inner strap; (vii) thickness of outer strap; and (viii) efficiency of the joint.	**10**
9	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/mm^2. The permissible shear stress for the spring wire is 30% of the ultimate tensile strength (G = 81 370 N/mm^2). Calculate (i) wire diameter; and (ii) number of active coils.	**10**
	UNIT-III	
10	A centrifugal pump is driven by 10 kW power 1440 rpm electric motor. There is a reduction gearbox between the motor and the pump. The pump shaft rotates at 480 rpm. The design torque is 150% of the rated torque. The motor and pump shafts are made of plain carbon steel 40C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 4. Assume (S_{sy} = 0.5S_{yt}). Calculate: (i) diameter of the motor shaft ;and (ii) diameter of the pump shaft.	**10**

11	A cone clutch is used to connect an electric motor running at 1440 rpm with a machine which is stationary. The machine is equivalent to a rotor of 150 kg mass and radius of gyration as 250 mm. The machine has to be brought to the full speed of 1440 rpm from stationary condition in 40s. The semi-cone angle is 12.5°. The mean radius of the clutch is twice the face width. The coefficient of friction is 0.2 and the normal intensity of pressure between contacting surfaces should not exceed 0.1 N/mm^2. Assuming uniform wear criterion, Calculate: (i) the inner and outer diameters; (ii) the face width of friction lining; (iii) the force required to engage the clutch; and (iv) the amount of heat generated during each engagement of clutch.	**10**
	UNIT-IV	
12	A single-row deep groove ball bearing is subjected to a radial force of 8 kN and a thrust force of 3 kN. The shaft rotates at 1200 rpm. The expected life L10h of the bearing is 20 000 h. The minimum acceptable diameter of the shaft is 75 mm. Select a suitable ball bearing for this application.	**10**
13	The following data is given for a 360° hydrodynamic bearing: journal diameter = 100 mm bearing length = 100 mm radial load = 50 kN journal speed = 1440 rpm radial clearance = 0.12 mm viscosity of lubricant = 16 cP Calculate: (i) minimum film thickness; (ii) coefficient of friction; and (iii) power lost in friction.	**10**