SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

School of Mechanical Engineering

B. Tech. (Branch) Minor / Major Examination (Even/Summer) 2018-19

Entry No: 17BME020

Date: 4th Feb.2019

Course Title: Machine Design

Total Number of Pages: [02]

Total Number of Questions: [04]

Course Code: MEL2017

Time Allowed: 1.5 Hours

Max Marks: [20]

Instructions / NOTE

i. Attempt All Questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume an appropriate data / information, wherever necessary / missing.

	Section - A		
Q1.	a) What are the causes of stress concentration?	[01]	CO1
	b) What is a repeated and reversed stress? Draw stress-time curve for repeated and reversed stress.	[01]	CO1
	c) What is the difference between failure due to static load and fatigue failure?	[01]	CO1
	d) What are the factors that affect endurance limit of machine part?	[01]	CO1
	e) Explain modified Goodman diagram for bending stresses?	[01]	CO1
	Section - B		
Q2.	A plate made of steel 45C8 (Sut = 630 N/mm2) in machined and cold drawn condition is shown in Figure1. It is subjected to a completely reversed axial load of 30 kN. The notch sensitivity factor q can be taken as 0.7 and the expected reliability is 90%. The factor of safety is 2.5. The size factor can be taken as 0.85. Determine the plate thickness for infinite life.	[05]	CO2
Q3.	The section of a steel shaft is shown in figure 2. The shaft is machined by turning process. The section at XX is subjected to a constant bending moment of 500 kN-m. The shaft material has ultimate tensile strength of 500 MN/m2, yield point of 350 MN/mm2 and endurance limit in bending for 7.5 mm diameter specimen of 210 MN/m2. The notch sensitivity factor can be taken as 0.8. The theoretical stress concentration factor may be interpolated from following tabulated values: (rf/d) 0.025 0.05 0.1 K_t 2.6 2.05 1.66 Where rf is fillet radius and d is shaft diameter. The reliability is 90%. Determine the life of the shaft.	[05]	CO2
Q4.	A rotating bar made of steel 45C8 (Sut = 630 N/mm2) is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is 315 N/mm2. Calculate the fatigue strength of the bar for a life of 90,000 cycles.	[05]	CO2

Course Outcomes

CO	Questions Mapping	Total Marks	Total Number of Students (to be appeared in Exam)
CO1	1(a),(b),(c),(d),(e)	05	35
CO2	2,3,4	15	

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

Minor-I (Even Semester) – 2017-18

Entry No: | | | | | | | | | | | |

Total number of pages:[1]

Total number of questions: 03

B.Tech. || ME || Sem IV

Machine Design

Subject Code: MEL-2017

Time allowed: 01 Hr **Max Marks: 20**

Important Instructions:

- All questions are compulsory
- Assume any missing data

(Q1) The state of stress $[\sigma_{ij}]$ in a loaded machine component is given below. If the yield stress of the machine component is 500 MPa, find the factor of safety using (1) Maximum Shear Stress Theory (2) Distortion Energy Theory (3) Maximum Principal Stress Theory.

$$\sigma_{ij} = \begin{bmatrix} 60 & 40 & 0 \\ 40 & -30 & 0 \\ 0 & 0 & -20 \end{bmatrix} MPa$$

(6)

(Q2) A machine component is subjected to a fluctuating load, which varies from $-150MPa$ **to** $300MPa$. Determine the ultimate stress σ_u of the given machine component using (1) Goodman's Theory (2) Soderberg's Theory (3) Gerber's Theory. Given: $\sigma_y = 0.55\sigma_u$, $\sigma_e = 0.5\sigma_u$, $F.O.S = 2$.

(6)

(Q3) Briefly explain the following theories of failure: (a) Distortion Energy Theory (b) Maximum Shear Stress Theory (c) Gerber's Theory (d) Goodman's Theory.

(8)

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

B. Tech. (Mechanical Engineering) Minor-II Examination (Even) 2017-18

Entry No: | | | | | | | | | |

Date: 16-03-2018

Total Number of Pages: [1]

Total Number of Questions: [2]

Course Name: Machine Design

Course Code: MEL-2017

Time Allowed: 01 Hour

Max Marks: [20]

Instructions / NOTE

i. Attempt All Questions.

ii. Support your answer with diagrams / neat freehand sketches, wherever appropriate.

iii. Assume any missing data to suit the derivation / answer.

Q1.	A circular shaft is subjected to combined bending and torsional fatigue loads. The bending load fluctuates between the maximum and minimum values given by M_{max} and M_{min}. The torsional load fluctuates between the maximum and minimum values given by T_{max} and T_{min}. The yield stress and the ultimate stress of the shaft material are σ_y and σ_u, respectively. The fully corrected endurance limit is σ_e. The stress concentration factors in bending and torsion are K_f and K_{fs}, respectively. Assuming the factor of safety equal to N, find the minimum acceptable diameter of the shaft using (a) Goodman's Criterion (b) Soderberg's Criterion (c) Gerber's Criterion (d) ASME Elliptic Criterion.	[12]
Q2.	Power of $150\ kW$ is to be transmitted at $250\ rpm$ by means of a solid shaft, which is supported by two pulleys. The pulleys induce a maximum bending moment of $1200\ Nm$ in the shaft. Find the diameter of the shaft if the allowable tensile stress and the allowable shear stress of the shaft material are $500\ MPa$ and $350\ MPa$, respectively. Use (a) Distortion Energy Theory (b) Maximum Shear Stress Theory (c) Maximum Principal Stress Theory.	[08]

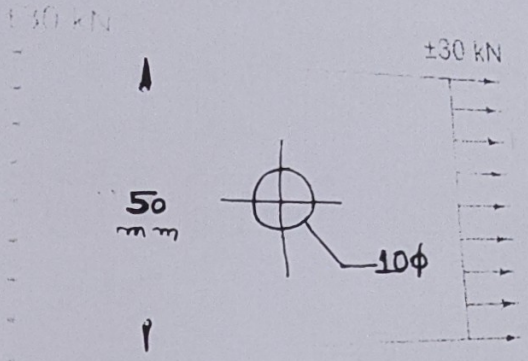


Figure 1

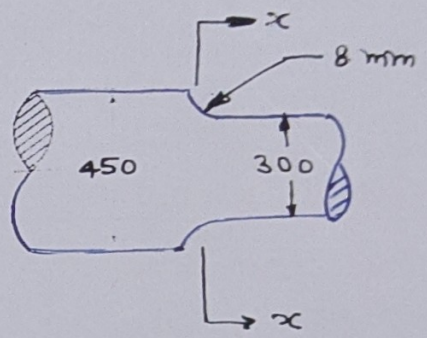
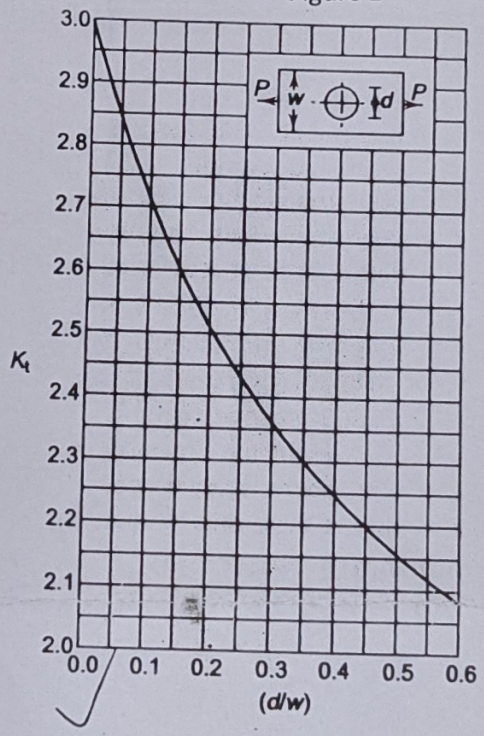
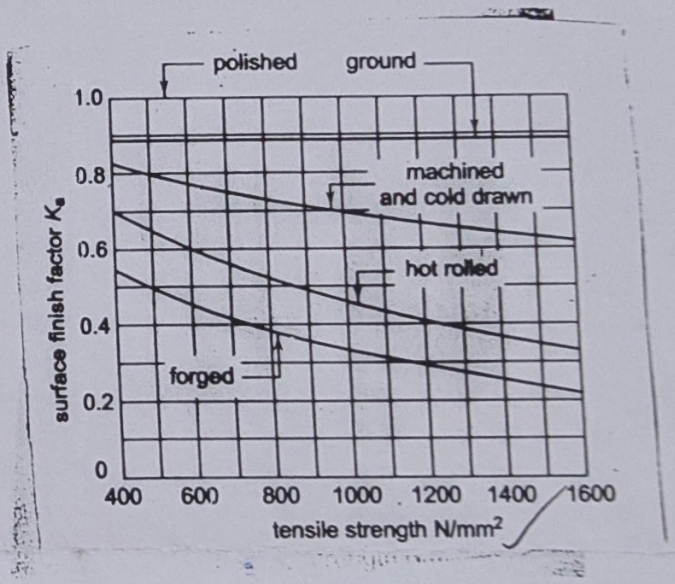


Figure 2





Surface finish factor

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

B. Tech. (Mechanical Engineering) Major Examination (Even) 2017-18

Entry No: | | | | | | | 0 | 0 | 7 |

Date: 27-04-2018

Total Number of Pages: [1]

Total Number of Questions: [5]

Course Name: Machine Design

Course Code: MEL-2017

Time Allowed: 03 Hours

Max Marks: [50]

Instructions / NOTE

i. Attempt All Questions.
ii. Support your answer with diagrams / neat freehand sketches, wherever appropriate.
iii. Assume any missing data to suit the derivation / answer.

Q1.	A helical compression spring, made of music wire, has a wire size of 2.5 mm, an outside coil diameter of 13 mm, a free length of 115 mm, 21 active coils, and both ends squared and ground. The spring is unpeened and will operate with a maximum load of 150 N. Estimate the factor of safety guarding against fatigue failure using (a) Torsional Gerber fatigue failure criterion with Zimmerli data. (b) Sines torsional fatigue criterion with Zimmerli data. (c) Torsional Goodman failure criterion with Zimmerli data.	[10]
Q2.	A music wire helical compression spring is needed to support a 100 N load after being compressed 50 mm. The ends of the spring are squared and ground. The diameter of the wire is 2 mm. Design the spring.	[10]
Q3.	A circular shaft is loaded in combined bending and torsion such that M_v= 70 Nm, T_v = 45 Nm, M_m = 55 Nm, and T_m = 35 N · m. The ultimate tensile stress of the shaft material is 700 MPa and the tensile yield strength is 560 MPa. The fully corrected endurance limit is 210 MPa. Assume K_f = 2.2 and K_{fs} = 1.8. With a design factor of 2.0, determine the minimum acceptable diameter of the shaft using the (a) Gerber criterion. (b) Soderberg criterion. (c) Goodman criterion. (d) ASME elliptic criterion.	[10]
Q4.	Design a journal bearing for a centrifugal pump subject to following conditions: The diameter of the journal is 75 mm and it is rotating at 1440 rpm. The load on the journal is 20 kN. The viscosity of the lubricating oil is 0.025 Ns/m^2 at the operating temperature of 60°C. The temperature of the ambient air is 15°C and the heat dissipation coefficient is given as 1228.1 W/m²/ °C.	[10]
Q5.	Write short notes on following: (a) Distortion Energy Theory (b) Goodman's Theory (c) Endurance limit and its correction factors	[10]

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Mechanical Engineering
B. Tech. (Branch) Minor / Major Examination (Even/Summer) 2018-19

Entry No: 17BME020

Total Number of Pages: [02]

Date: 4th Feb.2019

Total Number of Questions: [04]

Course Title: Machine Design

Course Code: MEL2017

Time Allowed: 1.5 Hours

Max Marks: [20]

Instructions / NOTE

i. Attempt All Questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume an appropriate data / information, wherever necessary / missing.

	Section - A		
Q1.	a) What are the causes of stress concentration?	[01]	CO1
	b) What is a repeated and reversed stress? Draw stress-time curve for repeated and reversed stress.	[01]	CO1
	c) What is the difference between failure due to static load and fatigue failure?	[01]	CO1
	d) What are the factors that affect endurance limit of machine part?	[01]	CO1
	e) Explain modified Goodman diagram for bending stresses?	[01]	CO1
	Section - B		
Q2.	A plate made of steel 45C8 (Sut = 630 N/mm2) in machined and cold drawn condition is shown in Figure1. It is subjected to a completely reversed axial load of 30 kN. The notch sensitivity factor q can be taken as 0.7 and the expected reliability is 90%. The factor of safety is 2.5. The size factor can be taken as 0.85. Determine the plate thickness for infinite life.	[05]	CO2
Q3.	The section of a steel shaft is shown in figure 2. The shaft is machined by turning process. The section at XX is subjected to a constant bending moment of 500 kN-m. The shaft material has ultimate tensile strength of 500 MN/m2, yield point of 350 MN/mm2 and endurance limit in bending for 7.5 mm diameter specimen of 210 MN/m2. The notch sensitivity factor can be taken as 0.8. The theoretical stress concentration factor may be interpolated from following tabulated values: (rf/d) 0.025 0.05 0.1 K_t 2.6 2.05 1.66 Where rf is fillet radius and d is shaft diameter. The reliability is 90%. Determine the life of the shaft.	[05]	CO2
Q4.	A rotating bar made of steel 45C8 (Sut = 630 N/mm2) is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is 315 N/mm2. Calculate the fatigue strength of the bar for a life of 90,000 cycles.	[05]	CO2

Course Outcomes

CO	Questions Mapping	Total Marks	Total Number of Students (to be appeared in Exam)
CO1	1(a),(b),(c),(d),(e)	05	35
CO2	2,3,4	15	

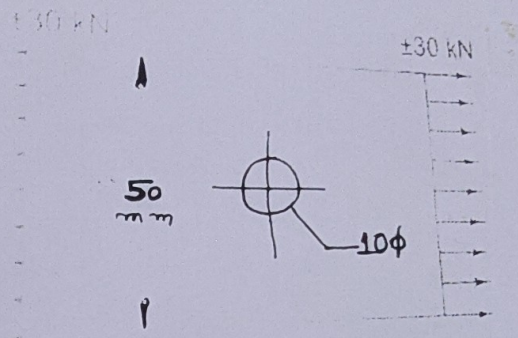


Figure 1

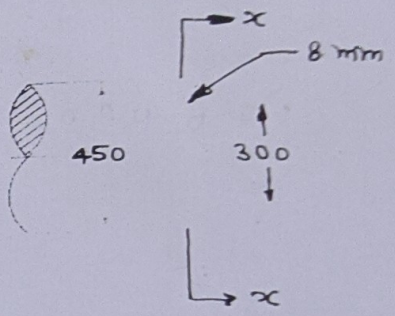
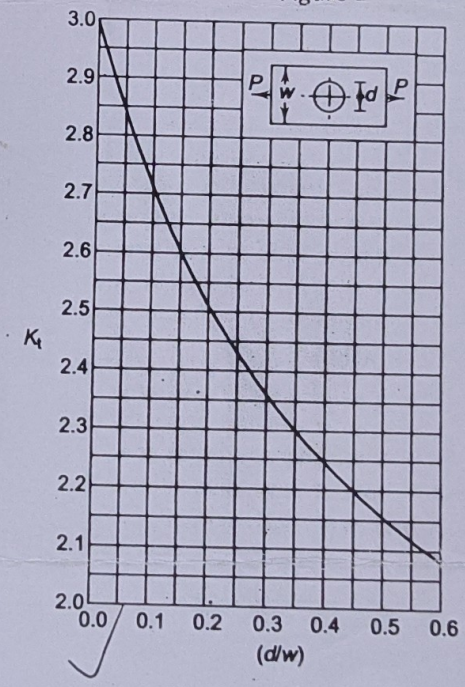
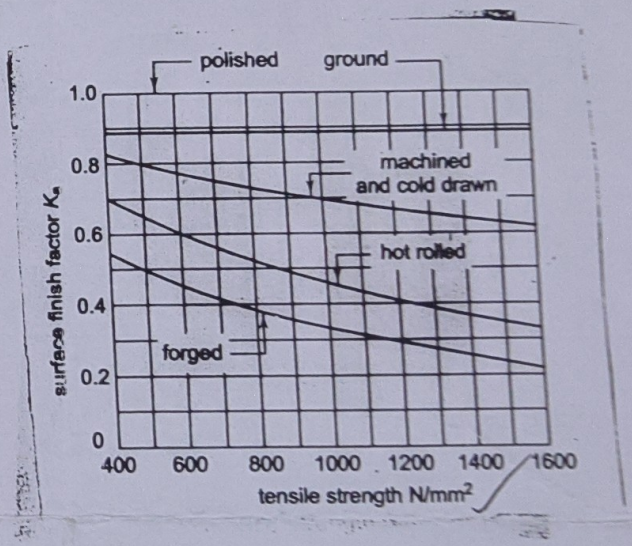


Figure 2





Surface finish factor

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Mechanical Engineering
B. Tech. (Branch) Minor-II 2018-19

Entry No: | | | | | | | 0 | 2 | 1 |

Total Number of Pages: [02]

Date: 16th March 13, 2019

Total Number of Questions: [04]

Course Title: Machine Design

Course Code: MEL 2017

Time Allowed: 1.5 Hours

Max Marks: [20]

Instructions / NOTE

i. Attempt All Questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume an appropriate data / information, wherever necessary / missing.

	Section - A		
Q1.	a. What do you understand by torsional rigidity?	[01]	CO3
	b. A hollow shaft has greater strength and stiffness than solid shaft of equal weight. Explain the statement.	[02]	CO3
	c. Why is saddle key suitable only for light duty?	[01]	CO4
	d. What is the disadvantage of keyed joint?	[01]	CO4
	Section - B		
Q2.	a. A solid circular shaft of diameter d is subjected to a bending moment of M_b and torsional moment of M_t. Prove that according to maximum principal stress theory, $\frac{S_{yt}}{f_s} = \frac{16}{\pi d^3}\left[M_b + \sqrt{(M_b)^2 + (M_t)^2}\right]$	[2.5]	CO3
	b. A hollow circular shaft of outer and inner diameters of d_o and d_i respectively is subjected to a bending moment of M_b and torsional moment of M_t. Prove that according to maximum shear stress theory, $\frac{0.5S_{yt}}{f_s} = \frac{16}{\pi d_o^{\,3}(1-C^4)}\left[\sqrt{(M_b)^2 + (M_t)^2}\right]$, $C = d_i/d_o$	[2.5]	CO3
Q3.	The layout of a shaft carrying two pulleys 1 and 2 and supported on two bearings A and B is shown in Figure 1. The shaft transmits 10 kW power at 400 rpm from pulley 1 to pulley 2. The diameters of pulley 1 and 2 are 250 and 500 mm respectively. The masses of pulley 1 and 2 are 10 and 30 kg respectively. The belt tensions act vertically downward and ratio of belt tension on tight side to slack side for each pulley is 3:1. The shaft is made of plain carbon steel 40C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 2. Estimate suitable diameter of shaft. If the permissible angle of twist is 0.5^0 per metre length, calculate the shaft diameter on the basis of torsional rigidity. Assume G= 79300 N/mm^2.	[05]	CO3
Q4.	A solid shaft of diameter d is used in power transmission. Due to modification of existing transmission system, it is required to replace the solid shaft by a hollow shaft of the same material and equally strong in torsion. Further, the weight of hollow shaft per metre length should be half of the solid shaft. Determine the outer diameter of hollow shaft in terms of d.	[05]	CO4

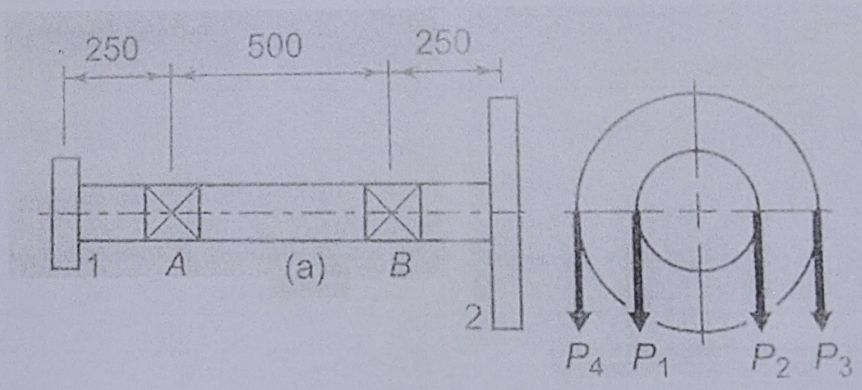


Figure 1

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

School of Mechanical Engineering

B. Tech. (Branch) Major 2018-19

Entry No: 1 7 B M E 0 2 1 | **Total Number of Pages:** [2]

Date: 13/05/2019 | **Total Number of Questions:** [5]

Course Title: Machine Design | **Course Code:** MEL 2017

Time Allowed: 3.0 Hours | **Max Marks: [50]**

Instructions / NOTE

i. Attempt All Questions.

ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.

iii. Assume an appropriate data / information, wherever necessary / missing.

	Section - A			
Q1.	a.	What is fluctuating stress? Draw stress-time curve for fluctuating stress.	[02]	
	b.	Which theories of failure are applicable for shaft? Why?	[02]	
	c.	Why is saddle key suitable only for light duty?	[02]	
	d.	What are two types of stresses in flat key?	[01]	
	e.	Write down load-deflection equation for helical spring.	[01]	
	f.	Two springs of stiffness k_1 and k_2 are connected in series. What is the stiffness of connection?	[01]	
	g.	What are the advantages of concentric spring?	[01]	
	Section - B			
Q2.	A cantilever beam made of cold drawn steel 40C8 (S_{ut} = 600 N/mm^2) and S_{yt} = 380 N/mm^2) is shown in Figure 1. The force P acting at the free end varies from -50 N to +150 N. The expected reliability is 90% and the factor of safety is 2. The notch sensitivity factor at the fillet is 0.9. Determine the diameter d of the beam at the fillet cross-section.		[10]	
Q3.	A transmission shaft supporting a spur gears B and pulley D is shown in Figure 2. The shaft is mounted on two bearings A and C. The diameter of pulley and the pitch circle diameter of gear are 450 and 300 mm respectively. The pulley transmits 20 kW power at 500 rpm to the gear. P_1 and P_2 are belt tensions in the tight and loose sides, while P_t and P_r are tangential and radial components of gear tooth force. Assume, $P_1 = 3\,P_2$ and $P_r = P_t \tan(20^0)$ The gear and pulley are keyed to the shaft. The material of the shaft is steel 50C4 (S_{ut} = 700 and S_{yt} = 460 N/mm^2). Determine the shaft diameter.		[10]	
Q4.	It is required to design a helical compression spring subjected to a maximum force of 1250 N. The deflection of the spring corresponding to the maximum force should be approximately 35 mm. The spring index can be taken as 6. The spring is made of patented and cold-drawn steel wire. The ultimate tensile strength and modulus of rigidity of the spring material 1100 and 81380 N/mm^2 respectively. The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile. Design the spring and calculate. i. Wire diameter ii. Mean coil diameter iii. Number of active coils iv. Total number of coils v. Free length of the spring		[10]	

Q5.	a. A semi-elliptic leaf spring used for automobile suspension consists of three extra full-length leaves and 15 graduated-length leaves, including the master leaf. The centre-to centre distance between two eyes of the spring is 1 m. The maximum force that can act on the spring is 75 kN. For each leaf, the ratio of width to thickness is 9:1. The modulus of elasticity of the leaf material is 207 000 N/mm^2. The leaves are pre-stressed in such a way that when the force is maximum, the stresses induced in all leaves are same and equal to 450 N/mm^2. Determine: i. The width and thickness of the leaves ii. The initial pre-load required to close the gap C between extra full-length leaves and graduated-length leaves.	(06)		
	b. Derive the nip of leaf spring, $$C = \frac{2PL^3}{Enbt^3}$$ where, P = Force applied at the end of the spring L = Length of cantilever or half the length of semi-elliptic spring E = Modulus of elasticity n = Total number of leaves b = Width of each leaf t = Thickness of each leaf	(04)		

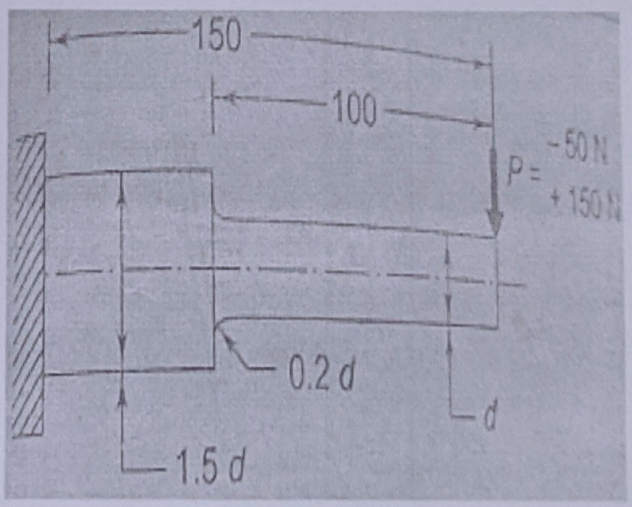


Figure 1

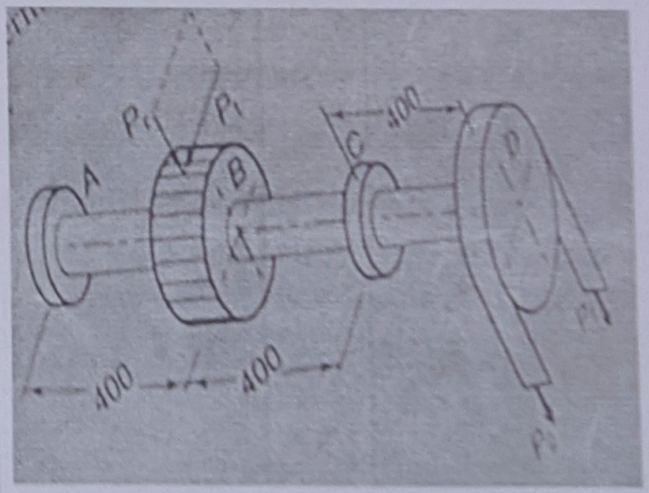


Figure 2

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Mechanical Engineering
B. Tech. (Branch) Minor / Major Examination (Even/Summer) 2018-19

Entry No: | | | | | | | | 2 | 1 |
Date: 4th Feb.2019
Course Title: Machine Design

Total Number of Pages: [02]
Total Number of Questions: [04]
Course Code: MEL2017

Time Allowed: 1.5 Hours
Max Marks: [20]

Instructions / NOTE

i. Attempt All Questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume an appropriate data / information, wherever necessary / missing.

	Section - A		
Q1.	a) What are the causes of stress concentration?	[01]	CO1
	b) What is a repeated and reversed stress? Draw stress-time curve for repeated and reversed stress.	[01]	CO1
	c) What is the difference between failure due to static load and fatigue failure?	[01]	CO1
	d) What are the factors that affect endurance limit of machine part?	[01]	CO1
	e) Explain modified Goodman diagram for bending stresses?	[01]	CO1
	Section - B		
Q2.	A plate made of steel 45C8 (Sut = 630 N/mm2) in machined and cold drawn condition is shown in Figure1. It is subjected to a completely reversed axial load of 30 kN. The notch sensitivity factor q can be taken as 0.7 and the expected reliability is 90%. The factor of safety is 2.5. The size factor can be taken as 0.85. Determine the plate thickness for infinite life.	[05]	CO2
Q3.	The section of a steel shaft is shown in figure 2. The shaft is machined by turning process. The section at XX is subjected to a constant bending moment of 500 kN-m. The shaft material has ultimate tensile strength of 500 MN/m2, yield point of 350 MN/mm2 and endurance limit in bending for 7.5 mm diameter specimen of 210 MN/m2. The notch sensitivity factor can be taken as 0.8. The theoretical stress concentration factor may be interpolated from following tabulated values: (rf/d) 0.025 0.05 0.1 K_t 2.6 2.05 1.66 Where rf is fillet radius and d is shaft diameter. The reliability is 90%. Determine the life of the shaft.	[05]	CO2
Q4.	A rotating bar made of steel 45C8 (Sut = 630 N/mm2) is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is 315 N/mm2. Calculate the fatigue strength of the bar for a life of 90,000 cycles.	[05]	CO2

Course Outcomes

CO	Questions Mapping	Total Marks	Total Number of Students (to be appeared in Exam)
CO1	1(a),(b),(c),(d),(e)	05	35
CO2	2,3,4	15	

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

School of Mechanical Engineering

B. Tech. (Branch) Minor (Even)-I 2020

Entry No: | | | | | | | | | |

Total Number of Pages: [02]

Course Title: Machine Design **Course Code: MEL2017**

Time Allowed: 1.5Hours **Max Marks: [20]**

Instructions / NOTE

i. Attempt All Questions.

ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.

iii. Assume an appropriate data / information, wherever necessary / missing.

	Section - A		
Q1.	a) What is casting process? Give the examples of components made by casting?	[01]	CO1
	b) What is forging? What are the advantages of forging process?	[02]	CO1
	c) What is the difference between failure due to static load and fatigue failure?	[01]	CO1
	d) What is stress concentration?	[01]	CO1
	e) What is the effect of stress concentration on ductile material?	[01]	CO1
	f) What is fluctuating stress? Draw stress-time curve for fluctuating stress.	[02]	CO1
	g) What is S-N curve?	[01]	CO1
	h) What are the factors that affect endurance limit of machine part?	[01]	CO1
	Section - B		
Q2.	A rectangular plate, 25 mm wide and 15 mm thick, made of brittle material and subjected to tensile force 20kN is shown in Figure 1. Calculate the stress at 10 mm diameter hole.	[2.5]	CO2
Q3.	A 40 mm diameter shaft is made of steel 50C4 (S_{ut} = 660 N/mm^2) and has a machined surface. The expected reliability is 99%. The theoretical stress concentration factor for the shape of the shaft is 1.6 and the notch sensitivity factor is 0.9. Determine the endurance limit of the shaft.	[2.5]	CO2
Q4.	A component machined from a plate made of steel 45C8 (S_{ut}=630 N/mm^2) is shown in Figure 2. It is subjected to a completely reversed axial force of 50 kN. The expected reliability is 90% and the factor of safety is 2.The size factor is0.85. Determine the plate thickness t for infinite life, if the notch sensitivity factor is 0.8.	[05]	CO3

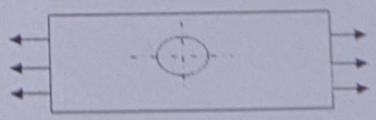


Figure 1

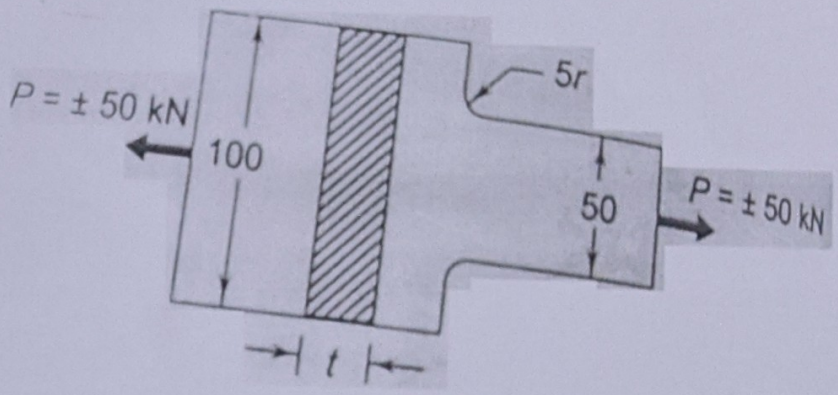
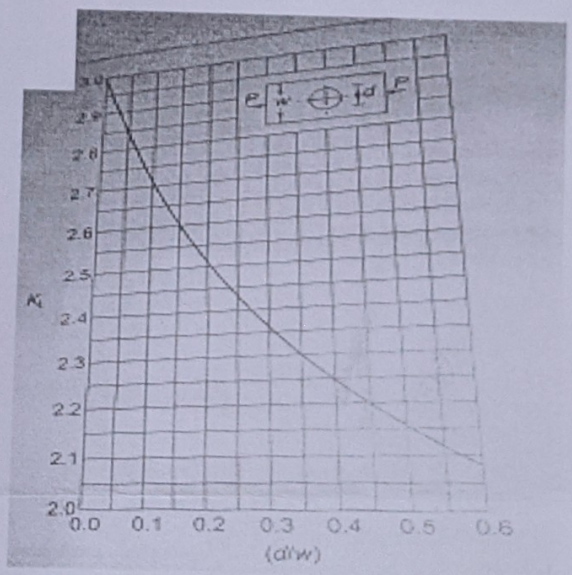
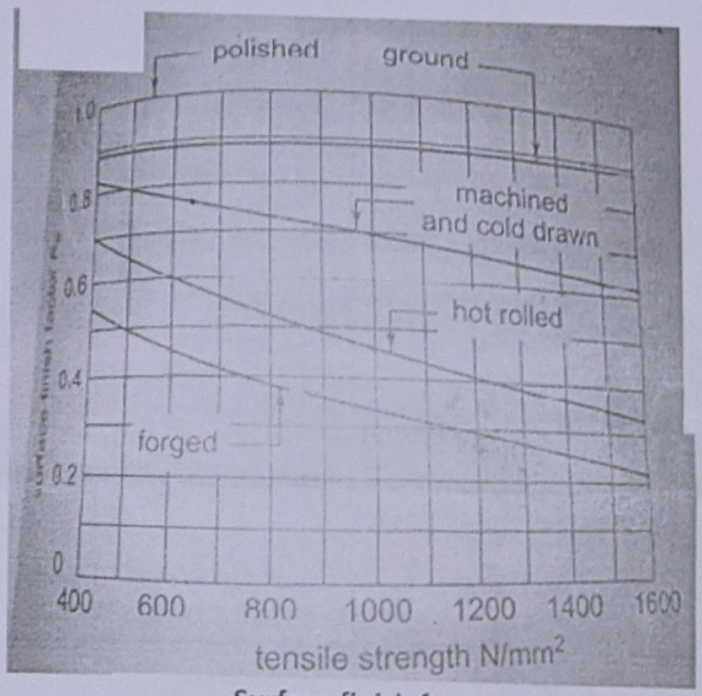


Figure 2



Stress Concentration factor



Surface finish factor

Diameter (d) mm	K_b
d<= 7.5	1.00
7.5< d <= 50	0.85
d >50	0.75

Reliability R (%)	K_c
90	0.897
95	0.868
99	0.814