MUZAFFARPUR INSTITUTE OF TECHNOLOGY, Muzaffarpur

COURSE FILE

OF

Design of Machine Elements

(021615)

Faculty Name:

Mr. Shobhit Gusain

ASSISTANT PROFESSOR, DEPARTMENT OF MECHANICAL ENGINEERING

Content

VISION OF THE DEPARTMENT

To strengthen the region through imparting superior quality technical education and research; which enables the fulfillment of industrial challenge and establish itself as a Centre of Excellence in the field of Mechanical Engineering.

MISSION OF DEPARTMENT

- To build an academic environment of teaching and lifelong learning for students to make them competitive in context with advance technological, economical and ecological changes.
- To enable the students to enhance their technical skills and communications through research, innovation and consultancy projects.
- To share and explore the accomplishments through didactic, enlightenment, R & D programs with technical institution in India and abroad.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

After 4 to 5 years of graduation a BE (ME) graduate would be able to :

- Use core competence acquired in various areas of Mechanical engineering to solve techno managerial issues for creating innovative products that leads to better livelihoods and economy of resources.
- To establish themselves as effective collaborators and innovators to address technical, managerial and social challenges.
- To equip students for their professional development through lifelong learning and career advancement along with their organizational growth.
- To serve as a driving force for proactive changes in industry, society and nation.

PROGRAMME OUTCOMES (PO)

Students who complete the B.E. degree in ME will have :

- An ability to apply the knowledge of mathematics, basic sciences and engineering concepts to solve the complex engineering problems.
- The ability to conduct experiments and to critically analyze and interpret the experimental data to reach at substantial outcomes.
- An ability to design systems, components, or processes to meet appropriate needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- An ability to identify, formulates, and solves the complex engineering problems.
- An ability to function on multi-disciplinary teams that leads the multi-disciplinary projects.
- An understanding of professional and ethical responsibility.
- An ability to communicate effectively with written, oral, and visual means.
- An ability to understand the impact of engineering solutions in a global, environmental, economical and societal context.
- An ability to recognize the need to engage in life-long learning.
- An ability to attain knowledge of contemporary issues.

- An ability to use the techniques, skills, and modern tools necessary for Mechanical engineering practice.
- Possess ability to estimate costs, estimate quantities and evaluate materials for design and manufacturing purposes.

COURSE OBJECTIVE AND COURSE OUTCOMES:

Institute / College Name :	MUZAFFARPUR INSTITUE OF TECHNOLOGY		
Program Name	**B.E. MECHANICAL**		
Course Code	021615		
Course Name	DESIGN OF MACHINE ELEMENTS		
Lecture / Tutorial (per week):	3/0	**Course Credits**	3
Course Coordinator Name	MR. SHOBHIT GUSAIN		

Course objective:

The main objective of any engineering design course is the fulfillment of some human need or desire. Broadly, engineering may be described as a judicious blend of science and art in which natural resources, including energy sources, are transformed into useful products, structures, or machines that benefit mankind. Science may be defined as any organized body of knowledge. Art may be thought of as a skill or set of skills acquired through a combination of study, observation, practice, and experience, or by intuitive capability or creative insight. Thus engineers utilize or apply scientific knowledge together with artistic capability and experience to produce products or plans for products.

Course outcomes (CO): At the end of this subject, the students should be able to understand

- To familiarize the various steps involved in the Design Process.
- To understand the principles involved in evaluating the shape and dimensions of a component.
- To satisfy functional and strength requirements of machine elements.
- To learn to use standard practices and standard data.
- To learn to use catalogues and standard machine components.

MAPPING OF COs AND POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	3	-	-	-	-	-	1	2	2
CO2	3	3	3	2	1	-	-	-	-	1	-	2
CO3	3	2	2	3	-	-	-	-	-	3	-	2
CO4	3	3	4	2	-	-	2	1	-	1	1	2
CO5	3	3	2	2	-	-	2	1	-	2	1	3

Correlation level: 1- slight (Low) 2- moderate (Medium) 3-substantial (High)

SYLLABUS

Topics	No of lectures	Weightage
Definition, Design Procedure, Types of Design, Factors to be considered in design	2	6%
Manufacturing consideration in machine design, factor of safety, Ergonomics, Standardization	2	6%
Types of materials used in mechanical engineering, various properties of engineering materials, Types of steel and cast iron, BIS designation of steels	3	10%
Bending equation, torsion equation, eccentric axial loading, combined bending and torsion, theories of failure, design against static load	5	9%
Stress concentration, notch sensitivity, Design for infinite life, Design for finite life, Soderberg, Goodman and Gerber criteria for design, fluctuating loads in combined bending and torsion	4	15%
Types of rivets and welds, Design of rivets based on shearing, tearing and crushing failure, Design of rivets and welds subjected to eccentric loading, Design of rivets and welds subjected to torsional loading	4	14%
Engineering application of knuckle joint and cotter joint, design of knuckle and cotter joint subjected to axial loading, thick pressure vessel design, thin pressure vessel design	8	9%
Classification of keys, design of square key and kennedy key, classification of shafts, Design of shaft subjected to various loading conditions on the basis of strength and rigidity	6	11%
Features of flat belt drives, flat belt materials, flat belt stresses and its specification, types of design factors, design procedure,	3	8%
Stresses in a helical spring, deflection of a helical	4	12%

spring, classification and design of brakes, types of clutches, uniform wear theory, uniform pressure theory, design of clutches		

GATE Syllabus of Design of Machine Elements:

Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs.

MUZAFFARPUR INSTITUTE OF TECHNOLOGY

B.Tech. 6th (Sixth) Semester, Mechanical Engineering, (2015 Batch) TIME TABLE

6th SEMESTER MECHANICAL
ROOM NO.47

DAY/ TIME	10:00-10:50	10:50-11:40	11:40-12:30	12:30-01:20	01:20-01:50	01:50-02:40	02:40-03:30	03:30-04:20
MON	HMT (AK)	CMStr. (NK)	NCM (SK)	INS. & MSR. (NKD)	**B**	SEMINAR		GATE CLASS
TUE	INS. & MSR. (NKD)	IE & A (IH)	NCM (SK)	DME (SG)	**R**	NCM TUT. (SK)		GATE CLASS
WED	NCM (SK)	CMStr. (NK)	IE & A (IH)	HMT (AK)	**E**	M1-DME LAB (SG, SK, RKR) / M2-CMStr. TUT. (NK)		
THU	INS. & MSR. (NKD)	IE & A (IH)	CMStr. (NK)	DME (SG)	**A**	M2-DME LAB (SG, SK, RKR) / M1-CMStr. TUT. (NK)		
FRI	HMT (AK)	DME (SG)	M1- INS. & MSR. TUT.(NKD)		**K**	M1-HMT LAB. (AK, NK, GK)/ M2- INS. & MSR. TUT. (NKD)		
SAT	M2- TUT. IE & A (IH)		GATE CLASSES			M2-HMT LAB. (AK, NK, GK)/ M1- INS. & MSR. TUT. (NKD)		

The first acronym is the subject and second acronym is the first and last initial of faculty names

STUDENT LIST:

S.NO.	Roll No	Name
1	15M01	ASHISH CHAURASIA
2	15M02	RAJ KAMAL
3	15M03	VIVEK KUMAR
4	15M04	RAM BHADRA JHA
5	15M05	RITU RAJ
6	15M06	SUMIT KUMAR
7	15M07	PAWAN KUMAR PIYUSH
8	15M08	HIMANSHU KUMAR
9	15M09	ANMOL
10	15M10	MADHU PRIYA
11	15M11	SANJAN KUMAR YADAV
12	15M12	PRAVEEN KUMAR
13	15M13	VIKASH KUMAR KESHRI
14	15M14	AHSAN SOHAIL
15	15M15	MUKESH KUMAR ROY
16	15M16	SAJAN KUMAR
17	15M17	SUMAN KUMAR SINHA
18	15M18	RITESH KUMAR
19	15M19	SHANUR RAHMAN WAHID
20	15M20	MD AFTAB ALAM
21	15M21	DHEERAJ KUMAR
22	15M23	SAROJ KUMAR PASWAN
23	15M24	MAYANK
24	15M25	ASHOK DAS
25	15M26	ALOKRAJ
26	15M28	ASHIWANI KUMAR
27	15M29	NEHAL ANSARI
28	15M30	DHARMENDRA KUMAR
29	15M31	ASHVANI KUMAR
30	15M32	DHANANJAY KUMAR
31	15M33	RAHUL KUMAR
32	15M34	RANJAN KUMAR
33	15M35	ANURAG KUMAR RAVI
34	15M36	RAVI RAJ
35	15M37	ANKIT AKASH
36	15M38	PRAMENDRA KUMAR
37	15M39	RAMESH KUMAR
38	15M40	GANGA RAM MANDAL
39	15M41	ROHIT KUMAR
40	15M42	UJJWAL KASHYAP

41	15M44	NISHANT KIRAN
42	15M46	AMAN KUMAR JHA
43	15M47	NITISH KUMAR
44	15M48	NAVEEN KUMAR
45	15M49	DHANANJAY KUMAR CHOUDHARY
46	15M50	AAKASH KUMAR
47	15M51	DEEPAK KUMAR
48	15M52	SURANJAN KUMAR
49	15M53	MONU KUMAR
50	15M54	SANJEEV KUMAR ADITYA
51	15M55	ISHA SHARMA
52	15M56	NEETU GUPTA
53	15M57	AMIT KUMAR
54	15M58	MERAJ AHMED
55	15M59	MANISH KUMAR SINGH
56	15M60	ABHINANDAN KUMAR
57	15M61	RAM KUMAR MAHTO
58	15M62	ROHIT RAJ
59	15M63	VIKAS KUMAR SAXENA
60	15M64	SUMIT KUMAR
61	15M65	PRAKASH KUMAR
62	15M66	ANAND MOHAN DEO
63	15M67	ADITYA KUMAR
64	16(LE)M01	ADITYA KUMAR
65	16(LE)M02	SHAKTI KUMAR
66	16(LE)M03	ROHIT KUMAR
67	16(LE)M04	KUMARI PRIYA RANJAN
68	16(LE)M05	KAMLESH KUMAR
69	16(LE)M06	KUMAR PRATIK VISHWAS
70	16(LE)M07	VIKRANT KUMAR
71	16(LE)M08	NIRBHAY KUMAR
72	16(LE)M09	RAUSHAN KUMAR SINGH
73	16(LE)M10	HIMANSHU CHANDRA

Text Books:

TB1: 'Design of Machine Elements' by V.B. Bhandari Sixth Edition, Standard Book House

TB2:Shigley's Mechanical Engineering Design, 9th Edition-McGraw-Hill.

Reference Books:

1. Design Data hand Book, S MD Jalaludin, Anuradha Publishers
2. Machine Design / R.N. Norton
3. Data Books :Mahadevan
4. Mech. Engg. Design / JE Shigley

Other readings and relevant websites

S.No.	**Link of Journals, Magazines, websites and Research Papers**
1.	https://www.sciencedirect.com/science/article/pii/.../pdf?md5...pid=1-s2.0...1
2.	academic.uprm.edu/pcaceres/Courses/MatEng3045/EME8-4.pdf
3.	http://mechanicaldesign.asmedigitalcollection.asme.org/article.aspx?articleid=1451585
4.	imechanica.org/files/Fatigue%20SF.pdf
5.	https://link.springer.com/article/10.1007/s00170-014-6152-5
6.	https://eclass.upatras.gr/modules/document/file.php/MECH1178

COURSE PLAN

Lecture Number	Date of Lecture	Topics	Web Links for video lectures	Text Book / Reference Book / Other reading material	Page numbers of Text Book(s)
1-2		**Introduction**		TB1, RB3	1-10
		Definition, Design Procedure, Types of Design, Factors to be considered in design	https://www.youtube.com/watch?v=mzWMdZZaHwI	http://nptel.ac.in/courses/112105125/pdf/Module-1_Lesson-1.pdf	
3-4		**Fundamentals of machine design**		TB1, RB3	10-18
		Manufacturing consideration in machine design, factor of safety, Ergonomics, Standardization	https://www.youtube.com/watch?time_continue=17&v=ofmbhbVCUqI	http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Machine%20design1/pdf/mod1les3.pdf	
5-7		**Engineering materials and their properties**		TB1, RB3	19-51
		Types of materials used in mechanical engineering, various properties of engineering materials, Types of steel and cast iron, BIS designation of steels	https://www.youtube.com/watch?v=m9l1tVXyFp8	http://nptel.ac.in/courses/112105125/pdf/Module-1_Lesson-2.pdf	
8-12		**Simple stresses in machine parts**		TB1, RB3	76-140
		Bending equation, torsion equation, eccentric axial loading, combined bending and torsion, theories of failure, design against static load	https://www.youtube.com/watch?v=Nmnat0qGROk	http://ocw.tudelft.nl/courses/watermanagement/irrigation-and-drainage/lectures/3-requirement-and-delivery/	
13-16		**Design against fatigue load**		TB1, RB3	144-184

		Stress concentration, notch sensitivity, Design for infinite life, Design for finite life, Soderberg, Goodman and Gerber criteria for design, fluctuating loads in combined bending and torsion	https://www.youtube.com/watch?v=jolY82CpmGo https://www.youtube.com/watch?time_continue=2317&v=0N_kKY_bByg	http://nptel.ac.in/courses/112106137/	
Mid-Semester Exam (Syllabus covered from 1-16 lectures)					
17-20		**Design of riveted and welded joints**		TB1, RB3	186-272
		Types of rivets and welds, Design of rivets based on shearing, tearing and crushing failure, Design of rivets and welds subjected to eccentric loading, Design of rivets and welds subjected to torsional loading	https://www.youtube.com/watch?v=J9Aj17MAyLY	http://nptel.ac.in/courses/105104103/3 http://nptel.ac.in/courses/105104103/4	
21-28		**Design of knuckle joint, cotter joint, pressure vessels**		TB1, RB3	759-783
		Engineering application of knuckle joint and cotter joint, design of knuckle and cotter joint subjected to axial loading, thick pressure vessel design, thin pressure vessel design	https://www.youtube.com/watch?v=OT6VcqvOoGY	http://nptel.ac.in/courses/112105125/pdf/Module-4_lesson-1.pdf http://nptel.ac.in/courses/112105125/pdf/Module-4_lesson-2.pdf http://nptel.ac.in/courses/112105125/pdf/Module-4_lesson-4.pdf	
29-35		**Design of keys and shaft**		TB1, RB3	328-380
		Classification of keys, design of square key and kennedy key, classification of shafts, Design of shaft subjected to various loading conditions on the basis of strength and rigidity	https://www.youtube.com/watch?v=G0bShPqHn5c https://www.youtube.com/watch?v=dKfriV8H9-8	http://nptel.ac.in/courses/112105125/pdf/mod8les1.pdf http://nptel.ac.in/courses/112105125/pdf/mod8les2.pdf	
36-38		**Design of belt drive and pulley**		TB1, RB3	495-535
		Features of flat belt	https://www.youtu	http://nptel.ac.in/cour	

		drives, flat belt materials, flat belt stresses and its specification, types of design factors, design procedure,	be.com/watch?v=nMsB6Soz4Hc https://www.youtube.com/watch?v=tPtlwiiSamI	ses/112105125/pdf/mod13les2.pdf http://nptel.ac.in/courses/116102012/83	
39-42		**Design of springs, clutches and brakes**		TB1, RB3	441-492
		Stresses in a helical spring, deflection of a helical spring, classification and design of brakes, types of clutches, uniform wear theory, uniform pressure theory, design of clutches	https://www.youtube.com/watch?v=bAh1yRzrYJs https://www.youtube.com/watch?v=ZldkigrDplc	http://nptel.ac.in/courses/112105125/pdf/mod8les1.pdf https://nptel.ac.in/courses/112105125/pdf/mod12les2.pdf http://nptel.ac.in/courses/112106137/pdf/3_5.pdf	

Department of Mechanical Engineering
021615 Design of Machine Elements
Assignment 1

1. Describe different types of rivets with the help of suitable diagrams. Discuss applications of each of them.

2. Define: (a) Stress concentration (b) Notch sensitivity (c) Endurance limit (d) Fatigue life (e) Ergonomics

3. A plate 50mm wide and made up of steel 20C8 ($S_{ut=}$440N/m^2) in hot rolled and normalized condition has a circular hole of 10mm diameter at the centre. It is subjected to a completely reversed axial load of 30 kN along the length. The notch sensitivity factor q can be taken as 0.8 and the expected reliability is 90%. The size factor is 0.85. The factor of safety is 2. Determine the plate thickness for infinite life.

4. What are the different types of threads used in power screws. Discuss their advantages, disadvantages and applications.

5. A bar is subjected to fluctuating tensile load from 20 kN to 100 kN. The material has yield strength of 240 MPa and endurance limit in reversed bending is 160 MPa. Determine the area of cross section of bar for a factor of safety of 2 according to the Soderberg principle.

Department of Mechanical Engineering
021615 Design of Machine Elements
Assignment II

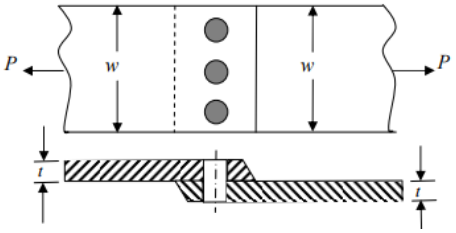
1. Define transmission shafts. Name and explain different types of transmission shafts.
2. Show that the hollow circular shaft whose inner diameter is half the outer diameter has a torsional strength equal to 15/16 of that of a solid shaft of the same outside diameter?
3. Determine the maximum shearing stress and elongation in a helical steel spring composed of 20 turns of 20-mm-diameter wire on a mean radius of 90 mm when the spring is supporting a load of 1.5 kN. G = 83 GPa.
4. Find the torque required to raise the load of 15kN and mean diameter of triple threaded screw being 46mm. Also given pitch=8mm and coefficient of friction is 0.15?
5. Design a clamp coupling to transmit 30 kW at 100 r.p.m. The allowable shear stress for the shaft and key is 40 MPa and the number of bolts connecting the two halves are six. The permissible tensile stress for the bolts is 70 MPa. The coefficient of friction between the muff and the shaft surface may be taken as 0.3.
6. Derive an expression for the maximum efficiency of a self locking screw.

MUZAFFARPURINSTITUTE OF TECHNOLOGY, MUZAFFARPUR
B.Tech 6th Semester Mid-Term Examination, 2018
Soil mechanics and Rock Mechanics (011X15)

Time: 2 hours **Full Marks: 20**

Instructions: (i) Attempt any five out of seven.
(iii) All questions carry equal marks.

Q.1. A single riveted lap joint of two similar plates is shown in the figure:



width of the plate w = 200 mm, thickness of the plate t = 5 mm, number of rivets n = 3, diameter of the rivet d_r = 10 mm, diameter of the rivet hole d_h = 11 mm, allowable tensile stress of the plate σ_p = 200 MPa, allowable shear stress of the rivet σ_s = 100 MPa and allowable bearing stress of the rivet σ_c = 150 MPa. Determine the maximum permissible load P in kN to avoid (a) crushing failure (b) tearing failure.

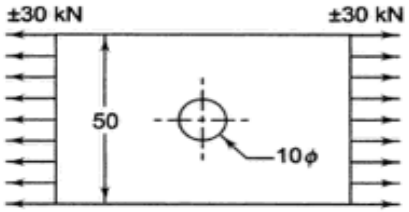
Q,2. Give the composition of following steels (a) Unalloyed free cutting steel 35C15S18 (b) Alloy steel 20Cr8Pb4.

Q.3. A steel machine part is statically loaded and has a yield strength of 320 MPa. For the following stress states find the factor of safety using maximum shear stress theory and maximum principal stress theory. σ_x = 60 MPa, σ_y = 60 MPa, τ_{xy} = 30 MPa.

Q.4. Define (a) Fatigue failure (b) Endurance limit (c) Notch sensitivity (d) Stress Concentration.

Q.5. A rotating bar of steel 45C8 (S_{ut}=630 N/mm^2) is subjected to completely reversed bending stress. The corrected endurance limit of the bar is 315 N/mm^2. Calculate the life of the shaft for an amplitude stress of 390 N/mm^2
.

Q.6. A plate 50mm wide and made up of steel 20C8 (S_{ut} = 440N/m^2) in hot rolled and normalized condition has a circular hole of 10mm diameter at the centre. It is subjected to a completely reversed axial load of 30 kN along the length. The notch sensitivity factor q can be taken as 0.8 and the expected reliability is 90%. The size factor is 0.85. The factor of safety is 2. Determine the plate thickness for infinite life.



Q.7. A bar is subjected to fluctuating tensile load from 20 kN to 100 kN. The material has yield strength of 240 MPa and ultimate strength of of 340 MPa. The endurance limit in reversed bending is 160 MPa. Determine the area of cross section of bar for a factor of safety of 2 according to the Soderberg principle and Goodman principle.

UNIVERSITY QUESTION PAPERS:

Code : 021615

B.Tech 6th Semester Exam., 2014

DESIGN OF MACHINE ELEMENTS

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

(v) Use of data books is permitted. Select data, if missing, suitably.

1. Answer any *seven* of the following as directed : 2×7=14

(a) Give two examples of bearing pressure and crushing stress in the design consideration of machine elements.

(b) A hollow shaft and a solid shaft are of equal weight. The hollow shaft has

(i) lower strength but greater stiffness

(ii) lower strength and lower stiffness

(iii) greater strength but lower stiffness

(iv) greater strength and also greater stiffness

(c) If a helical coil spring of stiffness K is cut into two identical half coil springs, the stiffness of each of these half spring will be ——.

(Fill in the blank)

(d) Cast iron is widely used for machine frames. Give two reasons.

(e) Give the composition of $25Cr_4Mo_2$.

(f) The resistance of fatigue of a material is measured by

(i) elastic limit

(ii) proportionate limit

(iii) endurance limit

(iv) ultimate strength limit

(Choose the correct option)

(g) What is the minimum efficiency required for the circumferential boiler joint?

(h) Why are multiple threaded screws not recommended in screw jack?

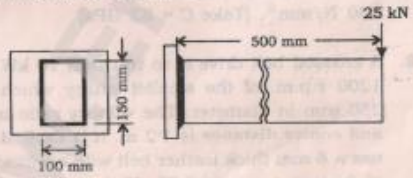
(i) Suggest suitable coupling for shafts with parallel misalignment.

(j) Name the three stresses induced in belt due to power transmission.

2. Design a cotter joint, made of 30C8 steel, to support a load of 50 kN which is subjected to slow reversals of direction. 14

3. Determine the main dimensions of the longitudinal joints of a boiler whose inner diameter is 1·7 m and pressure of steam is 20 bar. The allowable tensile, crushing and shear stresses of mild steel rivet are 80 N/mm^2, 120 N/mm^2 and 65 N/mm^2 respectively. Assume quadruple rivetted, zig-zag butt joint with unequal cover plates. 14

4. Determine the size of the welds to support by means of fillet welds of a beam of rectangular cross-section as shown in the figure below if the permissible shear stress in the weld is limited to 75 N/mm^2. 14



5. A mild steel shaft has to transmit 70 kW at 240 r.p.m. The allowable shear stress in the shaft material is limited to 45 MPa and the angle of twist is not to exceed 1° in a length

of 20 times the shaft diameter. Determine the shaft diameter and design a cast iron flange coupling of protected type for the shaft. The shear stress in the coupling bolts is to be limited to 30 MPa. 14

6. Design a screw jack for lifting a load of 20 kN through a distance of 200 mm. 14

7. A safety valve of 60 mm diameter is to blow off at a pressure of 12 bar. It is held on its seat by a close-coiled helical spring. The maximum lift of the valve is 10 mm. Determine main dimensions of a compression spring of spring index 5. Take initial compression of the spring as 35 mm. The maximum shear stress in the material of the spring wire is to be limited to 500 N/mm^2. [Take C = 82 GPa] 14

8. A crossed belt drive is to transmit 10 kW at 1200 r.p.m. of the smaller pulley which is 250 mm in diameter. The velocity ratio is 2 and centre distance is 1·2 m. It is desired to use a 6 mm thick leather belt with coefficient of friction equal to 0·25. If the permissible stress for the belt material is 2 N/mm^2, determine the width of the belt. [Take the mass density of the belt material as 1000 kg/m^3] 14

9. A single-disc clutch is required to resist a maximum torque 500 N-m. The outer radius of the friction lining is 30% more than the inner radius. The permissible intensity of pressure between the contact surfaces is 0·08 N/mm^2. The coefficient of friction is 0·25. Eight helical compression springs are used to provide axial force necessary to engage the clutch. If the stiffness of each spring is 36 N/mm, determine the size of the friction lining and initial compression in the spring. 14

★★★

 Code : 021615

B.Tech 6th Semester Exam., 2018

DESIGN OF MACHINE ELEMENTS

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Choose the correct option (any *seven*) : 2×7=14

(a) Steels used for automobile bodies and hoods are

(i) medium carbon steel

(ii) mild steel

(iii) high carbon steel

(iv) alloy steel

(b) Material used for self-lubricated bearing is

(i) acetal

(ii) polyurethane

(iii) polytetrafluoroethylene (Teflon)

(iv) Any one of the above

(f) A stress that varies in sinusoidal manner with respect to time from tensile to compressive (or vice-versa) and with zero mean is called

(i) reversed stress

(ii) fluctuating stress

(iii) repeated stress

(iv) varying stress

(g) In order to find the endurance limit, the rotating beam specimen is subjected to

(i) repeated stresses

(ii) reversed stresses

(iii) fluctuating stresses

(iv) maximum stress

(h) In design of screw jack from buckling considerations, the end conditions are assumed as

(i) both ends are hinged

(ii) both ends are fixed

(iii) one end fixed and other hinged

(iv) one end fixed and other free

(c) In forged components

(i) fiber lines are arranged in a predetermined way

(ii) fiber lines of rolled stock are broken

(iii) there are no fiber lines

(iv) fiber lines are scattered

(d) When a circular shaft is subjected to torque, the torsional shear stress is

(i) maximum at the axis of rotation and zero at the outer surface

(ii) uniform from axis of rotation to the outer surface

(iii) zero at the axis of rotation and maximum at the outer surface

(iv) zero at the axis of rotation and zero at the outer surface and maximum at the mean radius

(e) The thermal stresses are caused due to

(i) variation in temperature

(ii) high temperature

(iii) specific heat

(iv) latent heat

(i) In the running condition, the net force acting on the drum of centrifugal clutch is equal to

(i) the centrifugal force on shoe

(ii) the centrifugal force on shoe minus spring force

(iii) the centrifugal force on shoe plus spring force

(iv) the spring force

(j) The maximum shear stress in spring wire is induced at

(i) inner surface of the coil

(ii) outer surface of the coil

(iii) central surface of the coil

(iv) end coils

2. *(a)* What are the factors to be considered for selection of engineering materials for a machine component? Discuss the important manufacturing considerations in machine design. 7

(b) How will you select direction of fiber lines in forged components? 7

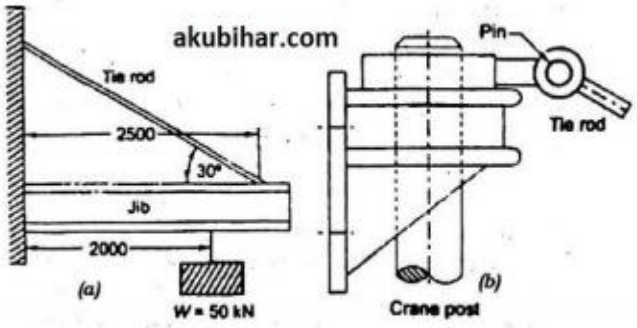
3. The force acting on a bolt consists of two components—an axial pull of 12 kN and a transverse shear force of 6 kN. The bolt is made of steel having $S_{yt} = 310\ N/mm^2$ and factor of safety is 2·5. Determine the diameter of the bolt using the maximum shear stress theory of failure. 14

4. A rotating bar made of steel having $S_{ut} = 620\ N/mm^2$ is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is $310\ N/mm^2$. Calculate the fatigue strength of the bar for a life of 1,00,000 cycles. 14

5. A forged steel bar of 55 mm diameter is subjected to a reversed bending stress of $260\ N/mm^2$. The bar is made of 40C8 steel ($S_{ut} = 610\ N/mm^2$). Calculate the life of the bar for a reliability of 90%. 14

6. A transmission shaft carries a pulley midway between the two bearings. The bending moment at the pulley varies from 200 N-m to 600 N-m, as the torsional moment in the shaft varies from 70 N-m to 200 N-m. The frequencies of variation of bending and torsional moments of steel FeE 400 ($S_{yt} = 400\ N/mm^2$ and $S_{ut} = 540\ N/mm^2$). The corrected endurance limit of the shaft is $210\ N/mm^2$. Determine the diameter of the shaft using a factor of safety of 2·5. 14

7. The layout of a wall crane and the pin-joint connecting the tie-rod to the crane post is shown in the figures *(a)* and *(b)* respectively. The tension in the tie-rod is maximum, when the load is at a distance of 2 m from the wall. The tie-rod and the pin are made of steel having $S_{yt} = 250\ N/mm^2$ and factor of safety is 3·0. Determine the diameter of the tie-rod and the pin. 14



LIST OF THE EXPERIMENTS

S. No.	Experiment Detail
1	Design of cotter joint
2	Design of knuckle joint
3	Design of rivets subjected to eccentric load
4	Design of shaft subjected to combined bending and torsion
5	Design of rivets subjected to eccentric load
6	Design of helical spring

RESULT OF THE STUDENTS

College Roll	Reg. No	University Roll No.	Name	Total Attendance	Marks of Attendance	Class Test-I/Class Test-II	End Semester Exam	Total of Col 6+7+8	Total Attendance	Marks of Attendance	Class Performance	Comprehensive Viva Voice	Total of Col 11+12+13	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Full Marks		5	5	20	30		5/10	5/10	10/20	20/40	
15M01	15102107066		ASHISH CHAURASIA		5	5	17	27		5	5	09	14	
15M02	15102107067		RAJ KAMAL		5	5	20	30		5	5	10	20	
15M03	15102107068		VIVEK KUMAR		5	5	12	22		5	5	08	18	
15M04	15102107069		RAM BHADRA JHA		5	5	15	25		5	5	09	19	
15M05	15102107070		RITU RAJ		4	5	16	25		4	5	09	18	
15M06	15102107071		SUMIT KUMAR		5	5	15	25		5	5	09	19	
15M07	15102107072		PAWAN KUMAR PIYUSH		5	5	15	25		5	5	09	19	
15M08	15102107073		HIMANSHU KUMAR		4	5	15	24		4	5	09	19	
15M09	15102107074		ANMOL		5	5	19	29		5	5	10	20	
15M10	15102107075		MADHU PRIYA		5	5	20	30		5	5	10	20	
15M11	15102107076		SANJAN KUMAR YADAV		5	5	15	25		5	5	09	19	
15M12	15102107077		PRAVEEN KUMAR		4	5	18	27		4	5	09	18	
15M13	15102107078		VIKASH KUMAR KESHRI		4	5	17	26		4	4	09	17	
15M14	15102107079		AHSAN SOHAIL		4	5	10	19		4	5	09	18	
15M15	15102107080		MUKESH KUMAR ROY		5	5	20	30		5	5	10	20	
15M17	15102107081		SUMAN KUMAR SINHA		4	5	13	22		5	4	09	18	
15M18	15102107082		RITESH KUMAR		5	5	19	29		5	5	09	19	
15M23	15102107084		SAROJ KUMAR PASWAN		5	5	16	26		5	5	09	19	
15M24	15102107085		MAYANK		5	5	16	26		5	5	09	19	
15M25	15102107086		ASHOK DAS		5	5	15	25		5	5	09	19	

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ge Roll	Reg. No	University Roll No.	Name	Total Attendance	Marks of Attendance	Class Test-I/Class Test-II	End Semester Exam	Total of Col 6+7+8	Total Attendance	Marks of Attendance	Class Performance	Comprehensive Viva Voice	Total of Col 11+12+13	Remarks
5M30	15102107091		DHARMENDRA KUMAR		5	5	14	24		5	5	09	19	
15M31	15102107092		ASHVANI KUMAR		5	5	14	24		5	5	09	19	
15M32	15102107093		DHANANJAY KUMAR		4	5	14	23		5	4	09	18	
15M34	15102107094		RANJAN KUMAR		4	5	09	18		5	4	09	18	
15M35	15102107095		ANURAG KUMAR RAVI		4	5	15	24		5	4	09	18	
15M36	15102107096		RAVI RAJ		4	5	13	22		5	4	09	18	
15M37	15102107097		ANKIT AKASH		5	5	13	22		5	5	08	18	
15M38	15102107098		PRAMENDRA KUMAR		5	5	15	25		5	5	09	19	
15M39	15102107099		RAMESH KUMAR		5	5	10	20		5	5	09	19	
15M40	15102107100		GANGA RAM MANDAL		5	5	15	25		5	5	09	19	
15M41	15102107101		ROHIT KUMAR		5	5	12	22		5	5	09	19	
15M42	15102107102		UJJWAL KASHYAP		5	5	18	28		5	5	09	19	
15M44	15102107104		NISHANT KIRAN		5	5	19	29		5	5	10	20	
15M46	15102107105		AMAN KUMAR JHA		5	5	14	24		5	5	09	19	
15M47	15102107106		NITISH KUMAR		5	5	19	29		5	5	09	19	
15M48	15102107107		NAVEEN KUMAR		5	5	11	21		5	5	08	18	
15M49	15102107108		DHANANJAY KUMAR CHOUDHARY		4	5	10	19		5	4	09	18	
15M50	15102107109		AAKASH KUMAR		5	5	15	25		5	5	08	18	
15M51	15102107110		DEEPAK KUMAR		5	5	18	28		5	5	09	19	
15M52	15102107111		SURANJAN KUMAR		5	5	15	25		5	5	09	19	
15M53	15102107112		MONU KUMAR		5	5	19	29		5	5	09	19	
15M54	15102107113		SANJEEV KUMAR ADITYA		5	5	10	25		5	5	09	19	
15M55	15102107114		ISHA SHARMA		5	5	18	28		5	5	10	20	
15M56	15102107115		NEETU GUPTA		5	5	14	24		5	5	09	19	
15M57	15102107116		AMIT KUMAR		5	5	15	25		5	5	09	19	
15M59	15102107117		MANISH KUMAR SINGH		5	5	12	22		5	5	08	18	
15M60	15102107118		ABHINANDAN KUMAR		5	5	12	22		5	5	09	19	
15M61	15102107119		RAM KUMAR MAHTO		5	5	18	28		5	5	09	19	
15M62	15102107120		ROHIT RAJ		5	5	12	22		5	5	09	19	
15M16	15102107121		SAJAN KUMAR		5	5	12	22		5	5	09	19	
15M20	15102107122		MD AFTAB ALAM		5	5	14	24		5	5	09	19	
15M21	15102107123		DHEERAJ KUMAR		5	5	15	25		5	5	09	19	

College Roll	Reg. No	University Roll No.	Name	Total Attendance	Marks of Attendance	Class Test-I/Class Test-II	End Semester Exam	Total of Col 6+7+8	Total Attendance	Marks of Attendance	Class Performance	Comprehensive Viva Voice	Total of Col 11+12+13	Remarks
15M58	15102107124		MERAJ AHMED		5	5	10	25		5	5	09	19	
15M19	15102107125		SHANUR RAHMAN WAHID		5	5	12	22		5	5	09	19	
15M33	15102107277		RAHUL KUMAR		5	5	17	27		5	5	09	19	
15M65	15104107195		PRAKASH KUMAR		5	5	13	23		5	5	09	19	
15M63	15104107198		VIKAS KUMAR SAXENA		5	5	17	27		5	5	09	19	
15M66	15104107204		ANAND MOHAN DEO		5	5	14	24		5	5	09	19	
15M67	15104107212		ADITYA KUMAR		5	5	15	25		5	5	09	19	
15M64	15104107213		SUMIT KUMAR		5	5	16	26		5	5	09	19	
16(LE)M09	16102107901		RAUSHAN KUMAR SINGH		5	5	13	23		5	5	09	19	
16(LE)M10	16102107902		HIMANSHU CHANDRA		5	5	14	24		5	5	09	19	
16(LE)M06	16102107903		KUMAR PRATIK VISHWAS		5	4	08	17		5	4	09	18	
16(LE)M01	16102107904		ADITYA KUMAR		5	5	13	23		5	5	09	19	
16(LE)M02	16102107905		SHAKTI KUMAR		5	4	11	20		5	4	09	18	
16(LE)M08	16102107906		NIRBHAY KUMAR		5	5	13	23		5	5	09	19	
16(LE)M03	16102107907		ROHIT KUMAR		5	5	16	26		5	5	10	20	
16(LE)M05	16102107908		KAMLESH KUMAR		5	5	11	21		5	5	09	19	
16(LE)M04	16102107909		KUMARI PRIYA RANJAN		5	5	17	27		5	5	10	20	
16(LE)M07	16102107910		VIKRANT KUMAR		5	5	11	21		5	5	09	19	

RESULT ANALYSIS