2|b
26|11|14

Bhartiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING
(An Autonomous Institution Affiliated to University of Mumbai)

ME (Mech), Sem - I with MC Design
2014

Total Marks : 100 Duration : 4 hrs

CLASS/SEM : M.E. (Mech) - I SUBJECT: CAD

Master

- Attempt any five questions out of seven questions
- If there are sub questions, answers to sub questions should be grouped together Computer Aided Design.
- Figures to the right indicate full marks

Q.No.1 (a) A triangle is defined by three vertices A(0,2,1) B (2,3,0) C(1,2,1). Find the final coordinates after it is rotated by 45 degree around a line joining the points (2,2,2) and (1,1,1) **(10)**

(b) Use the Cohen-Sutherland algorithm to clip two lines P1 (40,15) & P2 (75,45) and P3 (70,20) & P4 (100,10) against a window A (50,10), B (80,10), C (80,40) and D (50,40). **(10)**

Q.No.2 (a) Triangle PQR has vertices as P (2, 4), Q (4, 6), and R (2, 6). It is desired to reflect through an arbitrary line L whose equation is Y=0.5x+2. Calculate the new vertices of triangle and show the results graphically **(10)**

(b) Write a C++ program for Bresenham's Circle Algorithm & then using it produce at least five points along the circumference of the circle with radius = 20 and centered at (50,50) **(10)**

Q. No. 3 (a) Explain the different types of Geometric Modeling techniques in detail **(10)**
(b) Write a C++ program for Bresenham's Line Algorithm **(10)**

Q.No.4 (a) Construct the Bezier Curve of the order 3 and with 4 polygon vertices A(1,1), B (2,3) C (4,3) and D (6,4) by finding the coordinates at P (0), P (1/4), P (1/2), P (3/4) **(10)**
(b) How is Reverse Engineering used in Automotive Industries? Explain some of the data capture techniques along with neat sketches ? Also List some software's of Reverse Engineering **(10)**

Q. No.5 Explain the following **(20)**

1. Characteristics of Bezier curves
2. Virtual Reality
3. Sutherland Hodgeman polygon clipping Algorithm

with mfc Design

ME(Mech), Sem-I, Cad, 26/11/19.

(Computer Aided Design)

Q. No. 6 (a) Explain Different types of Rapid Prototyping techniques along with neat sketches **(12)**

(b) Explain in detail Gouraud Shading Algorithm **(05)**

(c) Explain CSG & B-Rep **(03)**

Q. No. 7 Write Short Notes on (Any Four) **(20)**

1. Polymorphism & Inheritance in C++
2. Artificial Intelligence in design
3. Structured Query Language (SQL)
4. Application of Relational data Bases in Mechanical Engineering
5. Concurrent Engineering
6. Graphics Standards

ME (Mech. Engg. (Mach. Desi)), sem-I, Re-Exam.

16/12/14

BHARATIYA VIDYA BHAVAN'S

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)
MUNSHI NAGAR, ANDHERI (WEST), MUMBAI- 400 058

RE-EXAMINATION

CLASS/SEM: **M.E.(Machine Design) Sem I**

SUBJECT: **Machine Dynamics and Advanced Vibration**

Total Marks: **100**

Duration: **4 Hour**

Date: **November 2014**

Master

- Attempt any FIVE out of seven questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Assume suitable data if necessary.

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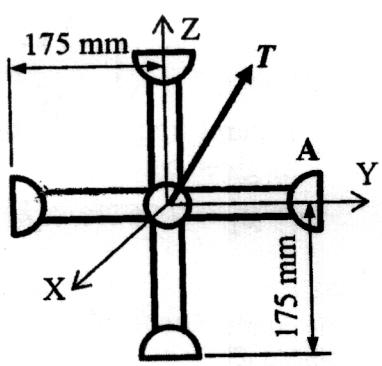
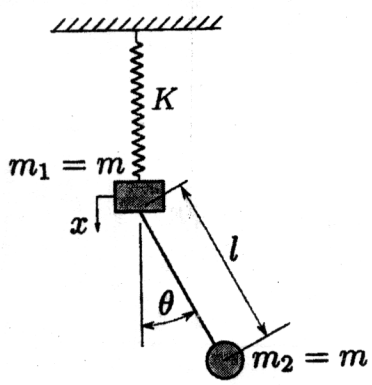
1. a) A lug wrench is moving in inertial space inside an orbiting space vehicle. The wrench has angular velocity $\bar{\omega} = 2\bar{\imath} + 3\bar{\jmath} - 3\bar{k}$ rad/s about an axis of rotation passing through centre of mass. A torque $\bar{T} = 3\bar{\imath} - 4\bar{\jmath} + 6\bar{k}$ N-m is exerted at the centre of wrench. What is the acceleration of end A at this instant? Approximate the wrench as two slender rods. The wrench weighs 10N. **(12)**



b) Derive the differential equation governing the motion of transverse vibration of a cable under tension. State the assumptions made during derivation. **(8)**

2. a) Develop the equation of motion for the system shown by using Lagrange's equation with x and θ as generalised coordinates. **(7)**



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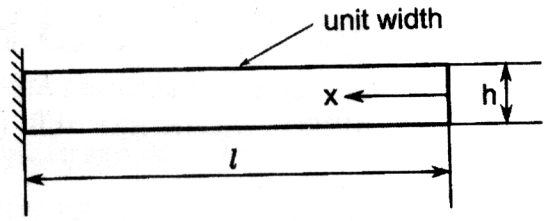
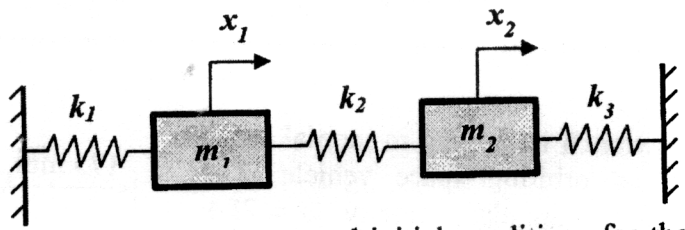
ME(Mech./Mech. Desi), Sem-I, Re-Exam. Machine Dynamics & Adv. Vibration. 16/12/14

b) Find fundamental frequency of transverse vibration of a cantilever beam shown in the figure using Rayleigh's method. Use deflection shape, $w(x) = (1 - x/l)^2$ **(5)**



c) Explain the graphical method employed for obtaining solution to the equation of motion of a non-linear vibrating system. Explain the meaning of terms: phase plane, trajectory and isocline. How the time solution can be obtained from the phase plane trajectories? **(8)**

3. a) Find free vibration response of spring-mass system shown below using modal analysis. Consider $m_1 = 2$, $m_2 = 3$, $k_1 = 10$, $k_2 = 20$, $k_3 = 30$. **(12)**



Natural frequencies, modes shapes and initial conditions for the system are as given below.

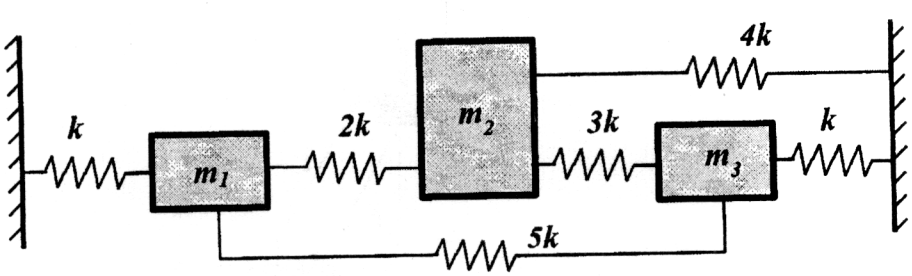
$$\omega_1 = 2.7615, \quad \{X^{(1)}\} = \begin{Bmatrix} 1 \\ 0.7374 \end{Bmatrix} X_1^{(1)}$$

$$\omega_2 = 4.9032, \quad \{X^{(2)}\} = \begin{Bmatrix} 1 \\ -0.904 \end{Bmatrix} X_1^{(2)}$$

$$\{x(0)\} = \begin{Bmatrix} 1 \\ 0 \end{Bmatrix}; \ \{\dot{x}(0)\} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$$

b) Write a short note on method to find response of a single degree of freedom system subjected to general periodic forcing conditions. **(4)**

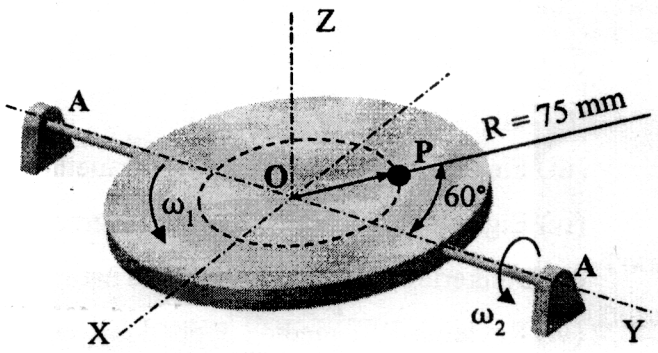
c) Define stiffness influence coefficient. Derive the stiffness matrix of the spring-mass system shown in the figure using stiffness influence coefficient method. **(4)**



page-②

ME(Mech/ Mach. Desi), Sem-I, Re-exam. Machine Dynamics & Adv. Vibration. 16/12/16

4. a) A particle P rotates at a constant angular speed of ω_1 = 4 rad/s on a platform, while the platform rotates with a constant angular speed of ω_2 = 25 rad/s about axis AA. Calculate the absolute velocity and acceleration of particle P at the instant when the platform is in the XY plane and radius vector to the particle forms an angle of 60° with the Y-axis as shown. **(12)**



b) An unbalanced flywheel during static balancing measurements shows amplitude of 10 μm and a phase angle of 25° anticlockwise from the phase mark. When a trial weight of magnitude 7 gm is added at an angular position 30° clockwise from the phase mark, the amplitude and the phase angle become 16 μm and 45° clockwise, respectively. Find the magnitude and angular position of the balancing weight required. **(8)**

5. a) Write short notes on following topics.
   (i) Singular or equilibrium point of a non-linear vibration system. **(4)**
   (ii) Limit cycle **(3)**
   (iii) Signature analysis for machine condition monitoring **(3)**

b) A diesel engine weighing 3200 N is supported on pedestal mount. It has been observed that the engine induces vibration into the surrounding area through its pedestal mount at an operating speed of 4200 rpm. Determine parameters of vibration absorber that will reduce the vibration when mounted on pedestal. The magnitude of exciting force is 320 N and amplitude of auxiliary mass is to be limited to 2.5 mm. **(6)**

c) Determine maximum percent error of a vibrometer in the frequency ratio range of $5 \leq r \leq \infty$. The damping ratio $\zeta = 0.65$. **(4)**

6. a) Explain using suitable example, Holzer's method for obtaining natural frequency and mode shapes of a vibration system. **(8)**

b) Discuss working principle of a vibration isolator. Define active and passive vibration isolators. What is transmissibility of an isolator? **(4)**

c) Describe any two types of vibration transducers. **(4)**

d) Write a short note on frequency measuring instruments. **(4)**

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ME(Mech)/(Mech.Desi), Sem-I, Re-Exam, Machine Dynamics & Adv. Vibration.

7. a) Write short notes on any FIVE of the following topics. **5x(4)**

(i) Ellipsoid of inertia

(ii) Euler's equations of motion

(iii) Flexibility influence coefficient method to formulate stiffness matrix

(iv) Eigenvalue problem for multi-degree freedom vibration systems

(v) Dunkerley's method to estimate natural frequency

(vi) Rayleigh-Ritz method applied to continuous vibration system

(vii) Jump phenomenon in non-linear vibration system

(viii) Mechanical and electro-dynamic vibration exciters

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19/11/14

BHARATIYA VIDYA BHAVAN'S

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)
MUNSHI NAGAR, ANDHERI (WEST), MUMBAI- 400 058

M.E Mech with ME Design Sem I Master 19/11/14.

END-SEMESTER

CLASS/SEM: **M.E.(Machine Design) Sem I** Total Marks: **100**

SUBJECT: **Machine Dynamics and Advanced Vibration** Duration: **4 Hour**

Date: **November 2014**

- Attempt any FIVE out of seven questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Assume suitable data if necessary.

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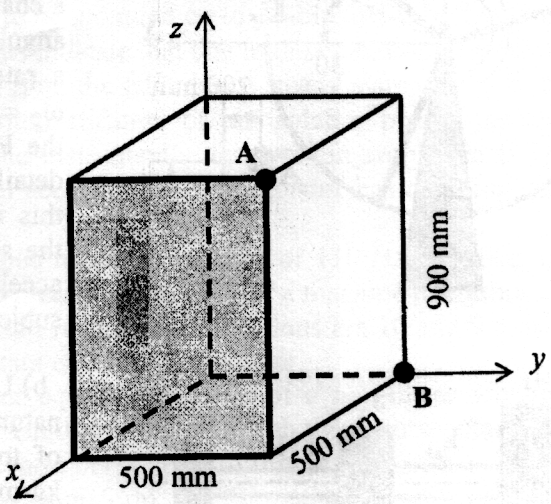
1. a) Answer to the following sub-questions in brief. **(14)**
   (i) State Chasles' theorem for describing the general motion of a rigid body.
   (ii) Write Euler's equations of motion. Specify conditions under which these equations are valid.
   (iii) What is meant by static and dynamic coupling in the context of equations of motion? How can you eliminate such coupling?
   (iv) Specify the form of differential equation governing motion of any two of the following systems: transverse vibration of cable, longitudinal vibration of bar and torsional vibration of shaft.
   (v) What is the difference between vibration isolator and vibration absorber?
   (vi) Give two examples with neat sketch of the nonlinear vibration systems.
   (vii) Sketch a mechanical vibration exciter and label important parts.

   b) A transport box as shown in the figure has mass of 500 kg. The centre of mass has coordinates: x_c = 200 mm, y_c = 200 mm, z_c = 400 mm. If at **A** we know that I_{yy} = 700 kg-m^2 and I_{yz} = 400 kg-m^2, find I_{yy} and I_{yz} at **B**. **(6)**



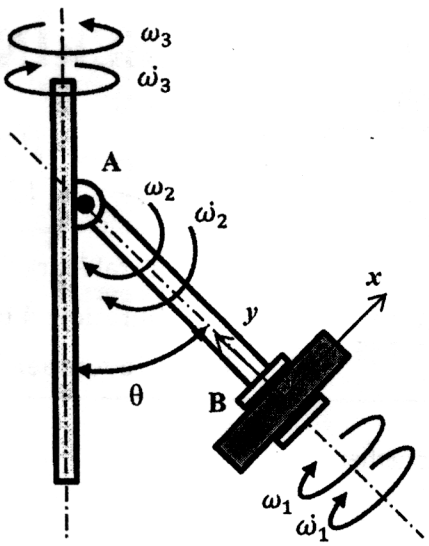
2. a) A 8 kg disc of 400 mm diameter rotates with speed ω_1 = 8 rad/s relative to rod AB. Rod AB rotates with speed ω_2 = 3 rad/s relative to vertical shaft, which rotates with speed ω_3 = 1 rad/s relative to the ground. What is the torque coming onto the **(12)**

Page - (1)

ME (Machi. Design). Sem-I, Machine Dynamics & Adv. Vibrations.

M.E (M) with M/c Design Sem I

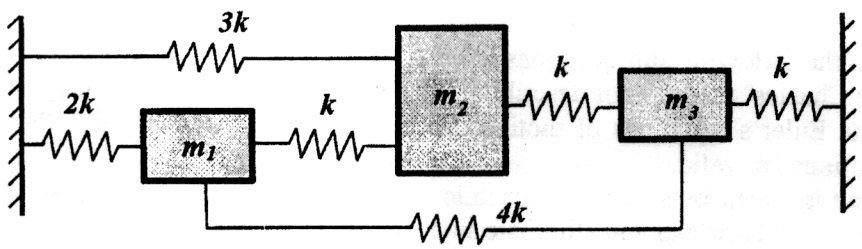
19/11/14



bearings at B due to the motion at a time when $\theta = 60°$? Take $\dot{\omega}_1 = 4\ rad/s^2, \omega_2 = 3\ rad/s^2, \dot{\omega}_3 = 2\ rad/s^2$.

b) Explain in brief how response to general periodic forcing conditions can be found for a single degree of freedom system using the method of Fourier series analysis. **(3)**

c) Derive the stiffness matrix of the spring-mass system shown in the figure using stiffness influence coefficient method. **(5)**



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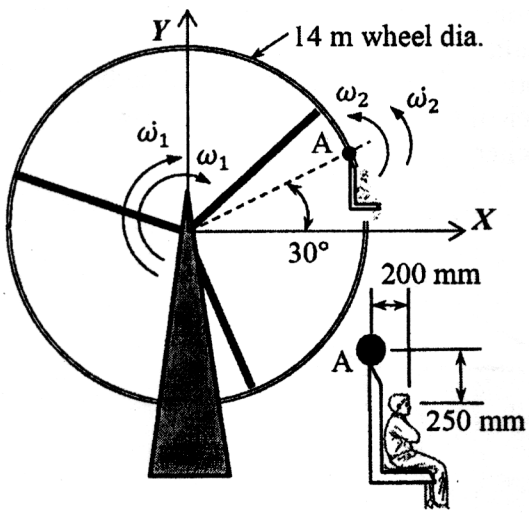
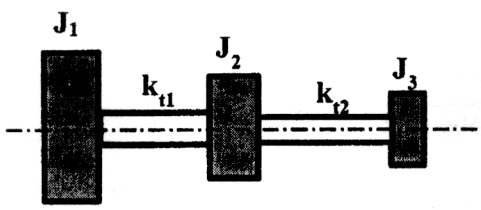


a) A Ferris wheel, at the instant shown, has an angular speed $\omega_1 = 0.15$ rad/sec and a rate of change of angular speed $\dot{\omega}_1 = 0.03$ rad/sec^2 relative to the ground. At this instant a chair shown in the diagram has an angular speed $\omega_2 = 0.35$ rad/sec and a rate of change of angular speed $\dot{\omega}_2 = 0.02$ rad/sec^2 both relative to the Ferris wheel. The figure shows details of the passenger's position at this instant. Note that the hinge of the seat is at A. How many g's of acceleration is the passenger's head subject to? **(12)**



b) Using Holzer's method estimate natural frequency and mode shape of torsional system shown. $J_1 = 8$ kg-m^2, $J_2 = 6$ kg-m^2, $J_3 = 4$ kg-m^2, $k_{t1} = 4$ MN-m/rad, $k_{t2} = 2$ MN-m/rad. Consider $\omega = 1200$ rad/s as seed value of frequency. Perform 3 iterations. **(8)**

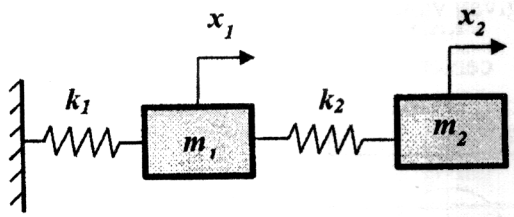
Page (2)

ME (Mech. Design), Sem-I, Machine Dynamics & Adv. Vibration 19/11/14.
M. Tech with Mech Design Sem I

4. a) Find free vibration response of spring-mass system shown below using modal analysis. Consider $m_1 = 10$, $m_2 = 1$, $k_1 = 30$, $k_2 = 5$. Natural frequencies, modes shapes and initial conditions for the system are as given below. **(12)**

$$\omega_1 = 1.5811, \{X^{(1)}\} = \begin{Bmatrix} 1 \\ 2 \end{Bmatrix} X_1^{(1)}; \ \omega_2 = 2.4495, \{X^{(2)}\} = \begin{Bmatrix} 1 \\ -5 \end{Bmatrix} X_1^{(2)}$$

$$\{x(0)\} = \begin{Bmatrix} 0 \\ 1 \end{Bmatrix}; \ \{\dot{x}(0)\} = \begin{Bmatrix} 0 \\ 1 \end{Bmatrix}$$



b) Derive the differential equation governing the motion of transverse vibration of a cable or string. State the assumptions made clearly. **(8)**

5. a) An unbalanced flywheel shows an amplitude of 7 μm and a phase angle of 17° clockwise from the phase mark. When a trial weight of magnitude 2 gm is added at an angular position 40° counter clockwise from the phase mark, the amplitude and the phase angle become 10 μm and 45° counter clockwise, respectively. Find the magnitude and angular position of the balancing weight required. **(8)**

b) Explain the procedure for obtaining solution to the equation of motion of a non-linear vibration system using graphical method. Explain meaning of following terms used in the method: (i) phase plane, (ii) trajectory and (iii) isocline. Describe the procedure employed to obtain time solution from phase plane trajectories. **(8)**

c) Write short note on any two types of transducers used for vibration measurement. **(4)**

6. a) A 25 kg laboratory instrument is to be mounted on to a table that is bolted to the floor in a laboratory. Measurements indicate that due to the operation of a nearby compressor that operates at 1400 rpm, the table has a steady state displacement of 0.5 mm. What is the maximum stiffness of an isolator, placed between instrument and table such that the instrument's acceleration amplitude is less than $0.22g$? (g is the gravitational acceleration). The isolator has damping ratio of 0.20. **(6)**

b) An accelerometer has an undamped natural frequency of 110 Hz and damping constant of 25 N-s/m. It is used to measure vibrations of a machine operating at a speed of 2000 rpm. If the actual and recorded accelerations are 10 and 9.5 m/s^2, find the mass and the spring constant of the accelerometer. **(4)**

c) Explain meaning of a singular or equilibrium point of a non-linear vibration system. Give the classification of equilibrium points with their representation on phase plane diagram. Describe in short the concept of limit cycles with a sketch. **(6)**

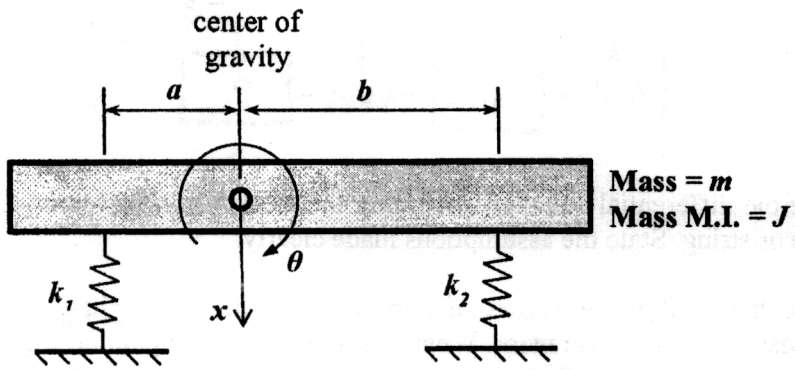
d) Explain the role of fast Fourier transform (FFT) method in digital signal processing of vibration data. **(4)**

MEC (Maen Design) Sem-I, Machine Dynamics & Adv. Vibration
M.E (CM) with MC Design Semi 19/11/14

7. a) Explain the working principle of the undamped vibration absorber. What is the major limitation of the undamped absorber? **(4)**

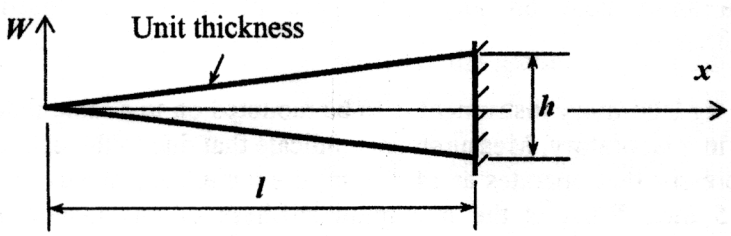
b) Briefly describe two types of frequency measuring mechanical instruments. **(4)**

c) Use Lagrange's equations to derive the differential equations governing the motion of system shown in the figure using x and θ as generalised coordinates. The kinetic energy of system is related to the translational and rotational velocities and the corresponding inertia properties. The potential energy is related to strain energy stored within the springs for their deformations corresponding to the given values of x and θ. **(6)**



d) Find the fundamental frequency of transverse vibration of tapered cantilever beam shown in the figure using Rayleigh's method. Assume deflection shape as **(6)**

$$W(x) = 1 - \frac{x^3}{l^3}$$



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21/11/14

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

ME (Mech), - Sem - I Machine Design

Nov 2014

Total Marks: 100 Duration : 4 Hours

CLASS/SEM: ME/ MECH/SEM-I Subject: Reliability Engineering and Design of Experiments

MASTER

- Attempt any FIVE questions out of SEVEN questions
- Figures to the right indicate full marks.
- Assume any suitable data if necessary.

Q1A. A data of 350 Suspension systems was reviewed to know association between type of suspension system and customer satisfaction . The response by Type of suspension are as follows. At alpha =0.05 do these data suggest an association between Type of suspension and customer satisfaction? [10]

	Air Suspension	Oil suspension	Total
Satisfied customer	14	25	39
Un-satisfied customer	159	152	311
Total	173	177	350

Q1B. Weight of 10 products are given in the table. Can we declare the variance of distribution of all wts. of all products from which the sample of 10 products was drawn is equal to 20 kgs? Test this at 5% and 1 % level of significance. [10]

SR.NO	1	2	3	4	5	6	7	8	9	10
WTS	38	40	45	53	47	43	55	48	52	49

Q2A. Compare the measures of central tendency. Compare the measures of the dispersion . Use the following points [10]

- Definition
- Formula
- Application
- Limitation

Q2B What are different types of Histogram patterns? What are their interpretations? [10]

Pugel

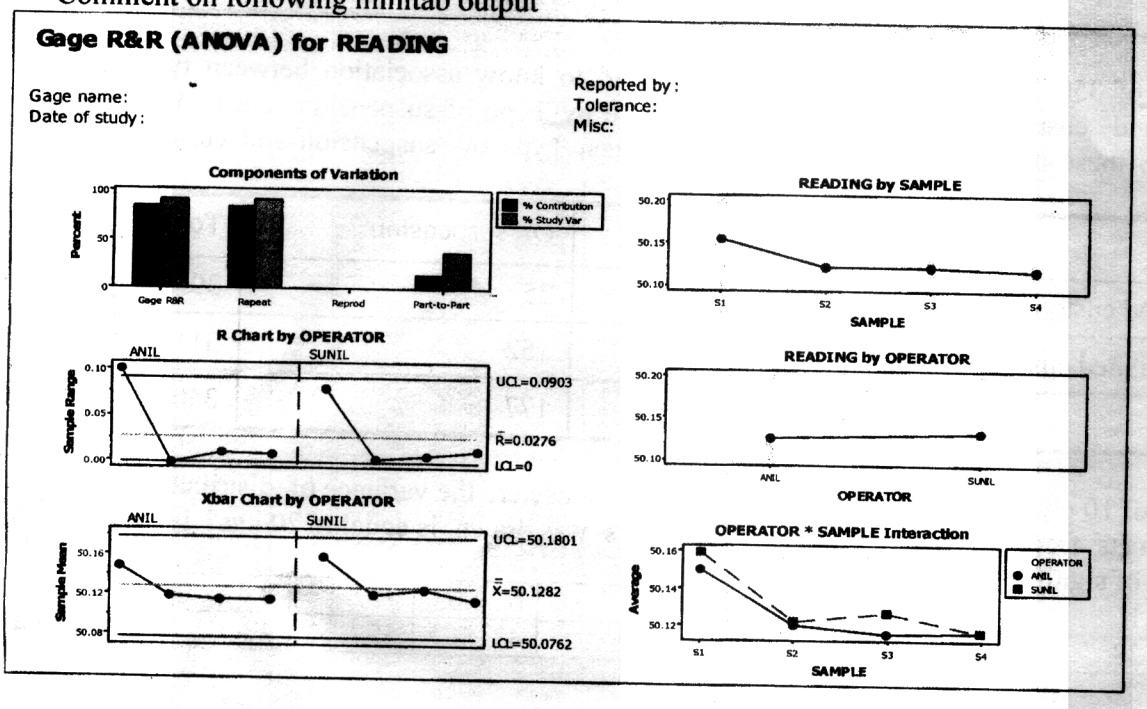
M.E(M) with mfc Design Sem I

Reliability Engg & Design of Experiments

Q3 Explain MSA with respect to following points 21/11/14 [20]

i. Guage R and R
ii. Repeatability
iii. Reproducibility
iv. Accuracy
v. Precision
vi. Linearity
vii. Stability
viii. Part to part variation
ix. Tolerance
x. Agreement Analysis
xi. Kappa value
xii. No of distinct categories

Comment on following minitab output



Q.4.Explain the followings with respect to Design of experiments. [20]

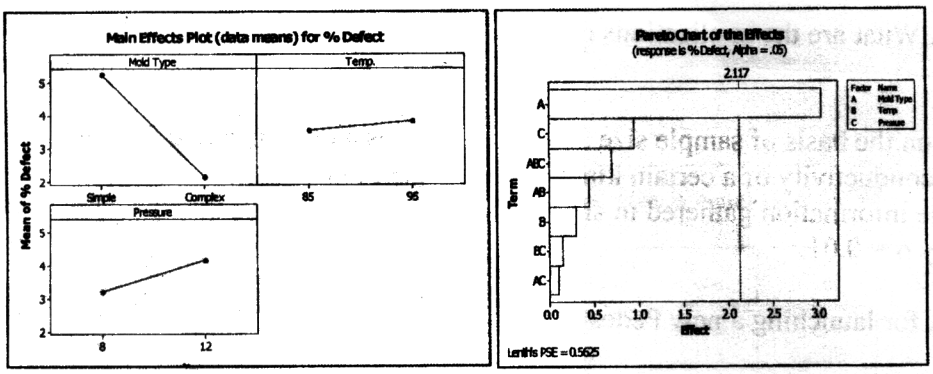
i. Advantages of DOE
ii. Replication
iii. Repetition
iv. Lurking Variable
v. Residual error
vi. Standard order Run Order
vii. Main effect Plots
viii. Interaction effect Plots
ix. Regression Equation
x. Possible permutation combinations of factors

Page 2

M.E(M) with mle design sem I
Reliability engg. I design of experiments.
21/11/14

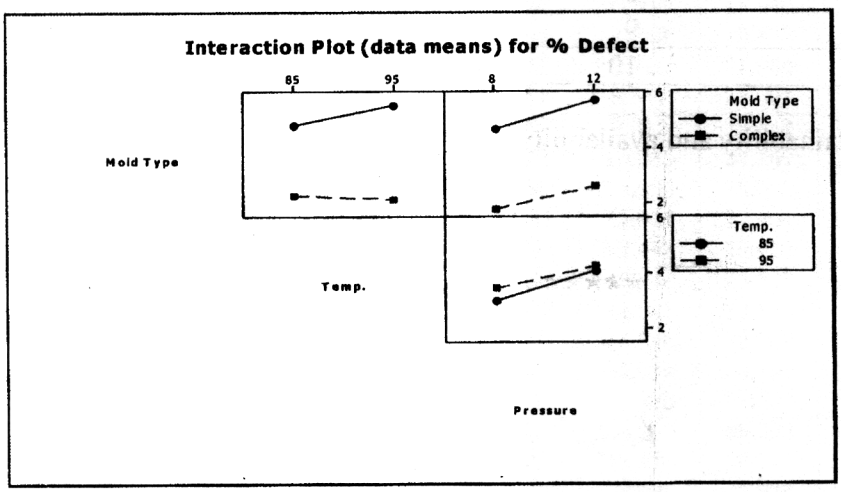
Full Factorial DOE

- **State Conclusions and recommendations**
- **Which setting will give least defects?**



Full Factorial DOE

Which factors have interaction effect ? Or is there no interaction effect?



Page B

M.E(M) with m/c Design Sem I
Reliability Engg & design of experiments

21/11/14

Q5A. What do you mean by Fault Tree analysis. When it is used? State and explain the various symbols used in it. Illustrate Calculation of reliability from FTA. [10]

Q5B. What do you mean by RBD. What are the applications of RBD. [10]

Q6A. Manufacturer wants to test on the basis of sample size 35 determinations and at 0.05 and 0.01 levels of significance whether the thermal conductivity of a certain kind of plate is 0.34 units, as has been claimed. The mean of sample is 0.343. From the information gathered in similar studies, we can expect that the variability of such determinations is given by $\sigma = 0.01$. [10]

Q6 B. Carry out a Design FMEA for launching a new Pedestal Fan. [10]

Q.7 A. In a life testing of a 10 specimens of a mini-mixture, the time to failure for each specimen is recorded as given in table. Calculate the mean failure rate h for T = 900 hrs. and the mean time to failure for all ten specimens. [10]

Specimen number	Time to failure hours	Specimen number	Time to failure hours
1	805	6	835
2	810	7	842
3	815	8	856
4	820	9	875
5	825	10	900

Q7 B. What do you mean by Maintainability and availability. Explain Reliability and maintainability trade off. [10]

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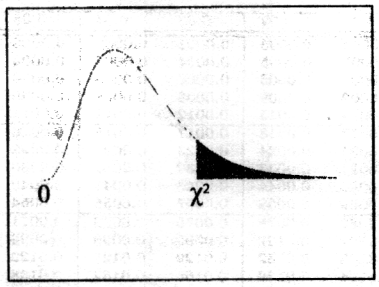
Page 03

M.E(M) with one Design Sem I
Reliability Engg & Design of Experiments.
21/11/14

Chi-Square Distribution Table



The shaded area is equal to α for $\chi^2 = \chi^2_\alpha$.

df	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.000	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169

m.E(m) with mle Design sem I
Reliability ranges & Design of Experiments
23/11/14

Table 1: Table of the Standard Normal Cumulative Distribution Function $\Phi(z)$

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

Page (6).

ME(Mech/Mach. Design) Sem-I, Re-exam, Stress Analysis (ME611). 4b 15/12/14

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

Re- examination Dec- 2014

Total Marks: 100 Duration: 4 Hours

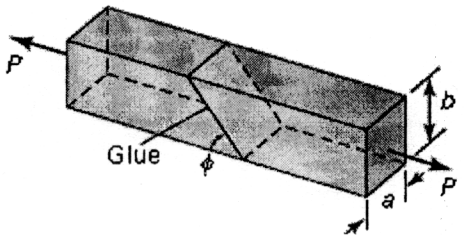
CLASS: M.E.(Mech) M/c Design, Sem: I SUBJECT: **Stress Analysis(ME611)**

- Attempt any **Five** questions out of **seven** questions.
- Figures to the right indicate full marks.
- Make any suitable assumption if needed with proper reasoning.
- Answer to all sub questions should be grouped together.

Master

Q. no.1 Determine i) deviatoric stress tensor, ii) normal and shearing stresses on octahedral plane,iii) principal stresses and their dcs, iv)plane of maximum shear; for a state of a stress as- $\begin{Bmatrix} 18 & 0 & 24 \\ 0 & -50 & 0 \\ 24 & 0 & 32 \end{Bmatrix}$ **(20)**

Q. no. 2 a) Two prismatic bars of 50 mm X 75 mm cross section are glued as shown in fig. The allowable normal and shearing stresses for the glued joint are 750 and 550 kPa respectively. Assuming that the strength of the joint controls the design, what is the largest axial load P that may be applied? $\Phi = 45^0$ **(06)**



b)Draw the Mohr's circle diagram for above stress state. **(07)**

c) For a given state of stress in Q.no.1 determine the strain matrix **(07)**
Take $E = 205*10^6$ kPa. $G = 79*10^6$ kPa

Q.no.3 a) Determine the total strain energy of the simply supported steel beam having rectangular cross section, 25mm wide and 50mm deep. E= 205 GPa; v = 0.3. A point load of 25 kN is acting at a distance of 1.5m from left of 3m long beam. **(10)**

b) Derive the three strain compatibility conditions. **(06)**

c) State and explain orthogonality and normality condition for dc's. **(04)**

Q.no.4 a) The displacement components are, $u = x^2+y$; $v = 3+z$; $w = x^2+2y$; determine the principal strains at (3,1,-2), also find the strain deviator. **(10)**

b) Find the state of stress for above strain components and the strain energy. **(10)**

Q.no.5 a) Derive the equation of equilibrium in polar coordinates. **(10)**

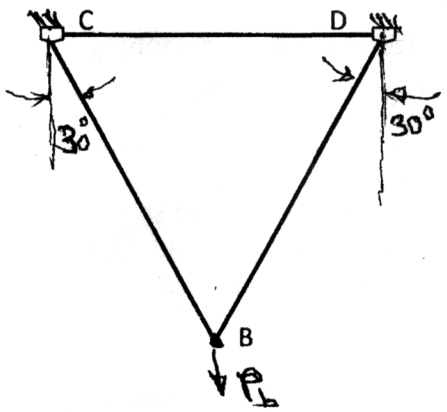
b) Derive the bi-harmonic equation in polar coordinates. **(10)**

ME (mech / maeh. Design), Sem-I, Re-exam. Stress Analysis (ME 611)

15/12/14

Q.no.6 a) Derive the stress equilibrium equation in 3-D. **(06)**

b) Two cables as shown in fig are made of a nonlinear material whose stress strain behavior is $\sigma = E\varepsilon - K\varepsilon^2$, where E= 207 GPa and K= 69000 GPa. The cross sectional area of each cable is 120mm^2, and both having a length L of 1650mm. Determine the vertical deflection of point B after a vertical load P_b of 15kN is applied. **(14)**



Q.no.7 a) Write short note on strain rosettes. **(05)**

b) List different types of strain gauges. Classify them. **(05)**

c) Discuss photoelasticity method of experimental stress analysis. **(10)**

Ub
17/11/14

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

End sem examination NOV- 2014

Total Marks: 100 Duration: 4 Hours

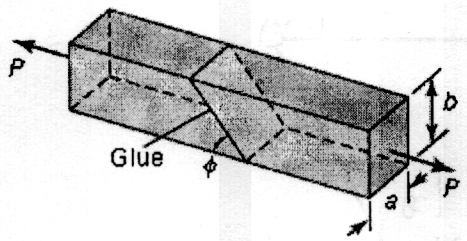
CLASS: M.E.(Mech) M/c Design, Sem: I SUBJECT: **Stress Analysis** Master.

- Attempt any **Five** questions out of **seven** questions.
- Figures to the right indicate full marks.
- Make any suitable assumption if needed with proper reasoning.
- Answer to all sub questions should be grouped together.

Q. no.1 a) Determine i) deviatoric stress tensor, ii) normal and shearing stresses on octahedral plane iii) principal stresses and their dcs, iv) plane of maximum shear; for a state of a stress as- **(20)**

$$\begin{matrix} 10 & 1 & -8 \\ 1 & -6 & 6 \\ -8 & 6 & 20 \end{matrix} \text{ MPa}$$

Q. no. 2 a) Two prismatic bars of 45 mm X 80 mm cross section are glued as shown in fig. The allowable normal and shearing stresses for the glued joint are 750 and 550 kPa respectively. Assuming that the strength of the joint controls the design, what is the largest axial load P that may be applied? $\Phi = 35^0$ **(06)**



b) Explain stress analysis using Mohr's circle method in 2-D. **(04)**

c) For a given strain at a point determine stress matrix **(06)**

$$\begin{matrix} 0.001 & 0 & -0.002 \\ 0 & -0.003 & 0.0003 \\ -0.002 & 0.003 & 0 \end{matrix}$$

Take $E = 205*10^6$ kPa. $G = 79*10^6$ kPa

d) Calculate the strain energy for above state of stress. **(04)**

Q.no.3 a) Determine the total strain energy of the simply supported steel beam having rectangular cross section, 25mm wide and 50mm deep. E= 205 GPa; v = 0.3. A point load of 15 kN is acting at a distance of 1m from left of 3m long beam. **(10)**

b) Write the compatibility equations in terms of stresses in z-x plane assuming a plane stress condition. **(05)**

c) State and explain orthogonality and normality condition for dc's. **(05)**

Q.no.4 a) Determine whether the following stress field are possible within elastic structural member in equilibrium. The c's are constant, and it is assumed that the body forces are negligible. **(06)**

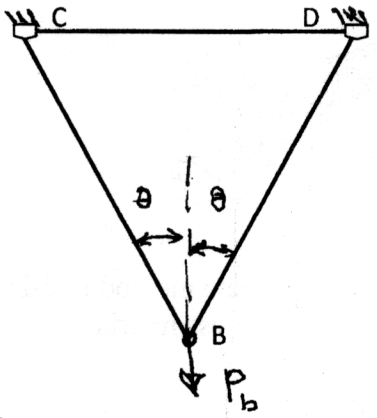
$$(a)\ \begin{bmatrix} c_1x + c_2y & c_5x - c_1y \\ c_5x - c_1y & c_3x + c_4 \end{bmatrix}, \qquad (b)\ \begin{bmatrix} -\frac{3}{2}x^2y^2 & xy^3 \\ xy^3 & -\frac{1}{4}y^4 \end{bmatrix}$$

b) The displacement components are, $u = x^2+y$; $v = 3+z$; $w = x^2+2y$; determine the principal strains at (3,1,-2) and direction of minimum principal strain, also find the strain deviator **(14)**

Q.no.5 a) Derive the equation of equilibrium in polar coordinates. **(10)**
b) Derive the bi-harmonic equation in polar coordinates. **(10)**

Q.no.6 a) Explain the first theorem of Castigliano.. **(06)**

b) Two cables as shown in fig are made of a nonlinear material whose stress strain behavior is $\sigma = E\varepsilon - K\varepsilon^2$, where E= 207 GPa and K= 69000 GPa. The cross sectional area of each cable is 125mm^2, and both having a length L of 1500mm. Determine the vertical deflection of point B after a vertical load P_b of 10kN is applied. ($\theta = 30^\circ$) **(14)**



Q.no.7 a) Write short note on strain rosettes. **(05)**
b) List different types of strain gauges. Classify them. **(05)**
c) Discuss photoelasticity method of experimental stress analysis. **(10)**

M.E.(Machine Design)/I - Re-exam.

18/12/14

Bhartiya Vidya Bhavan's

Sardar Patel College of Engineering

(An Autonomous Institution affiliated to University of Mumbai)

Re - Exam. **18.12.2014** **First Half 2014-15**

Class/Sem.: **M.E. (Machine Design)/I** Subject: **Tribology**

Duration: **4 Hrs.** Total Marks: **100**

MASTER FILE.

N.B.: 1. Answer any **five** questions.
2. Use of PSG Design Data book is permitted.
3. Assume suitable data, if necessary, giving reasons.
4. Draw neat sketches to illustrate your answers.
5. Figures to the right indicate full marks.

1. (a) Explain the use of various dimensionless parameters in the design of hydrodynamically lubricated journal bearings. **06**

   (b) Design a hydrodynamically lubricated journal bearing to support a radial load of 20 kN for a turbine shaft operating at 600 rpm. Select a suitable lubricating oil, show thermal balance and analyse the operating parameters such as oil temperature, viscosity, flow rate, minimum film thickness, maximum pressure, coefficient of friction, friction power loss, etc. **14**

2. (a) Explain briefly the procedure of selecting a suitable rolling contact bearing for different given applications. Discuss important factors. **06**

   (b) Select suitable type and size of the rolling contact bearing subjected to the following load cycle which is repeated. **14**

Sr. No.	Radial Load (kN)	Axial Load (kN)	Speed (rpm)	Percent Time	Service Factor
1	2.6	1.5	300	25	2.0
2	4.0	2.1	200	40	1.2
3	2.5	0.5	240	35	1.5

   The expected life is 12000 hrs. a probability of survival of 92 percent and an operating of temperature of 120° C.

3. (a) Describe the principles of operations and construction of a hydrostatically lubricated journal bearing. **06**

   (b) Design a circular pad hydrostatically lubricated thrust bearing to support a load of 25 kN for a shaft operating at 400 rpm. The bearing is fed from a manifold pressure of 50 bar through a capillary compensator, the film thickness is 0.04 mm, oil SAE 30 at 55° C. Assume recess to pad radii ratio for minimum pump power and compensator to bearing resistance ratio for maximum bearing stiffness condition. Calculate oil flow rate, pump power, friction power, bearing stiffness, oil temperature rise and capillary size, etc. **14**

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4. (a) Describe Kingsbury's electrical analogy method for measurement of pressures developed in hydrodynamically lubricated journal bearing. **08**

(b) Why are rolling contact bearings pre-loaded? Explain the methods of pre-loading angular contact ball bearing. **06**

(c) State most general form of 3-dimensional Reynolds' equation and explain significance of each term of the equation and applications. **06**

5. (a) State advantages, disadvantages of rolling contact bearing over sliding contact bearing. **06**

(b) Design a hydrodynamic rectangular plane-slider bearing, length in direction of motion B, 0.8 times the length in direction perpendicular to motion L, slider velocity u = 2 m/s, load W=20 kN, lubricating oil used SAE 30 at 65°C. Assume maximum load condition for which, $C_P = 0.16024$, $C_F = 0.753191$, $C_f = 4.7000$, and $C_C = 0.5779$. Find the inclination of the surfaces, coefficient of friction, power loss, heat generated, oil flow rate, oil temperature rise, etc. Use minimum film thickness 40 microns. **14**

6. (a) Define wear and explain briefly different types of wear. Describe in detail adhesive wear and its estimation. **10**

(b) Describe briefly the requirements and properties of lubricants, the additives used and their role in enhancing the properties of lubricants. **10**

7. Write notes on any four of the following: **20**

(a) Stick - Slip phenomenon.

(b) Failures in rolling contact bearings.

(c) Petroff's equation and its importance.

(d) Elastohydrodynamic lubrication and its importance.

(e) Theories of friction.

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24/11/14

Bhartiya Vidya Bhavan's

Sardar Patel College of Engineering

(An Autonomous Institution affiliated to University of Mumbai)

End Sem. Exam. ME (Mech. Design) Sem-I **24.11.2014** **First Half 2014-15**

Class/Sem.: **M.E. (Machine Design)/I** Subject: **Tribology**

Duration: **4 Hrs.** Total Marks: **100**

M.E. (M) with M/c Design Sem I. MASTER FILE

N.B.: 1. Answer any **five** questions.

2. Use of PSG Design Data book and certified charts is permitted.
3. Assume suitable data, if necessary, giving reasons.
4. Draw neat sketches to illustrate your answers.
5. Figures to the right indicate full marks.

1. (a) Define viscosity and viscosity index. Explain their importance in hydrodynamic lubrication and discuss the factors which affect their values. **06**

   (b) Design a hydrodynamically lubricated journal bearing to support a radial load of 12 kN for a turbine shaft operating at 600 rpm. Select a suitable lubricating oil, show thermal balance and analyse the operating parameters such as oil temperature, viscosity, flow rate, minimum film thickness, maximum pressure, coefficient of friction, friction power loss, etc. **14**

2. (a) Explain different types of compensators and their use in hydrostatic bearings. What is oil-lift ? **06**

   (b) Design a circular pad hydrostatically lubricated thrust bearing to support a load of 15 kN for a shaft operating at 300 rpm. The bearing is fed from a manifold pressure of 40 bar through an orifice compensator, the film thickness is 0.04 mm, oil SAE 20 at 53° C. Assume recess to pad radii ratio for minimum pump power and compensator to bearing resistance ratio for maximum bearing stiffness condition. Calculate oil flow rate, pump power, friction power, bearing stiffness, oil temperature rise and orifice size, etc. **14**

3. (a) Define static and dynamic load capacities of rolling contact bearings giving explanations of the conditions under which they are defined and their use. **06**

   (b) Select suitable type and size of the rolling contact bearing subjected to the following load cycle which is repeated. **14**

Sr. No.	Radial Load (kN)	Axial Load (kN)	Speed (rpm)	Percent Time	Load Type
1	2.6	1.4	300	35	With heavy shock
2	4.0	2.1	200	45	With mild shock
3	2.5	1.2	240	20	With moderate shock

The expected life is 10000 hrs., a probability of survival of 91 percent and an operating of temperature of 110° C.

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4. (a) A 600 mm square pad with four 200 mm square recesses placed at 60 mm from the corners, supports load of 600 kN. Calculate the recess pressures at liftoff and during sliding, flow rate for, a film thickness of 0.1 mm of SAE 30 oil at 45° C. Calculate also the resistance to slider motion at a velocity of 0.4 mm/s, coefficient of friction, pump power, oil temperature rise etc. If a capillary compensator is used in each recess circuit with a pressure drop equal to that for the bearing and a single pump, revise the calculations. **12**

(b) Describe Kingsbury's electrical analogy method for measurement of pressures developed in hydrodynamically lubricated journal bearing. Draw neat sketches . **08**

5. (a) Describe the constructional features and operating principles of fixed and tilting pad hydrodynamically lubricated thrust bearings. Compare fixed and tilting pad bearings. **06**

(b) Design a hydrodynamically lubricated thrust bearing for vertical turbine shaft to support a thrust 400 kN, when operating at 240 rpm. Use minimum oil film thickness of 0.06 mm, lubricating oil SAE 30 at 65°C. Assume maximum load condition for which, **14**

$C_P = 0.16024$, $C_F = 0.753191$, $C_f = 4.7000$, and $C_C = 0.5779$.

Find the inclination of the surfaces, coefficient of friction, power loss, heat generated, oil flow rate, oil temperature rise, etc.

6. (a) Define wear and explain briefly different types of wear. Describe in detail adhesive wear and its estimation. **10**

(b) Describe theory of elastohydrodynamic lubrication and its importance. Discuss the oil film film shape and pressure distribution with neat sketches **10**

7. Write notes on any four of the following: **20**
   (a) Preloading of rolling contact bearings.
   (b) Failures in hydrodynamically lubricated journal bearings.
   (c) Greases.
   (d) Friction materials for brakes and clutches and their properties.
   (e) Theories of friction.