UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME	:	VIBRATION
COURSE CODE	:	BNJ 30103
PROGRAMME	:	BNK
EXAMINATION DATE	:	DECEMBER 2014 / JANUARY 2015
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 "Packaging" shall mean all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods and from the producer to the user or the consumer.

(a) Hazards in distribution is a one of fundamental in packaging dynamic. Give a goals of the packaging technologist.

(3 marks)

(b) List **FOUR (4)** dynamic forced to be concerned as a package moves through distribution.

(8 marks)

(c) Imagine we used a sport car Audi S4 to deliver the wedding gift which will go from 0 to 100 km/hr in 4.0 seconds. What is average acceleration will the driver experience?

(6 marks)

(d) An wedding gift is dropped in the road surface. Find d_m and K_2 for a cushion which will limit the maximum acceleration of an 37.2 kg product to $G_m = 62$ g's in an height = 335.28 cm?

(8 marks)

Q2 Mechanical vibration is the motion of a particle or body which oscillates about a position of equilibrium. Most vibrations in machines and structures are undesirable due to increased stresses and energy losses.

(a) Define the Undamped, Damped and Linear Vibration.

(6 marks)

(b) The figure Q2 below shows a simple model of a motor vehicle that can vibrate in the vertical direction while traveling over a rough road. The vehicle has a mass of 1200kg. The suspension system has a spring constant of 400 kN/m and a damping ratio of $\zeta = 0.5$. If the vehicle speed is 20 km/hr, determine the displacement amplitude of the vehicle. The road surface varies sinusoidally with an amplitude of Y = 0.05m and a wavelength of 6m.

(19 marks)

Q3 (a) The vibration sensitivity of a product may be defined as those input vibration frequencies of sufficient amplitude occuring in the distribution environtment which can cause the resonance and failure of the product. Give a method may be used to determine vibration sensitivity.

(6 marks)

(b) Test method have been design to evaluate the performance of a packaging system when it is subjected to the vibration condition existing in the distribution environment. Give **THREE (3)** testing methods available depending on how the product to be shipped.

(9 marks)

(c) Consider a product with two critical element A and B. Element A has a natural frequency of 4Hz and 15 Hz for element B. Element A and B is far enough apart so that only one of them is vibrating. They do not touch and will not damage one another. However, if the product is subjected to 4 Hz and 15 Hz vibration simultaneously, the elements may hit one another and causing damage. Draw the response of element to Single Forcing Frequencies and Multiple Forcing Frequencies.

(10 marks)

Q4 (a) In the cushion design for product protection, the products critical velocity change is 2.54 m/sec and its critical acceleration is 60 g's. Calculate the maximum velocity change possible in a 0.762 m drop and give your conclussion.

(7 marks)

(b) Damage to the article is dependent not only on the maximum shock level at the article, but also on the shock duration. Give **THREE (3)** variables related to shock damage.

(6 marks)

(c) An article weighing 5.44 kg can sustain a maximum shock of 80g's (Gm=80). Find K_2 for a linear cushion which will limit the acceleration of the product to 80 g's in a 91.44 cm drop. What is the maximum deflection of the cushion? Find the duration (τ) of the shock pulse sustained by the article.

(12 marks)

Q5 (a) How mechanical shock occurs? Give **THREE (3)** damage factor that create mechanical shocks.

(5 marks)

(b) A shock machine produce half sine shock pulses of 20 milliseconds duration, and a product can withstand 100 g's. At higher accelerations there is damage to a critical element. The critical element has natural frequency = 80 Hz and the product weighs 1.814 kg. In distribution, a cushion K2 = 134.05 kg/cm is used and max drop height = 121.92 cm.

i. What is the frequency of the shock produced by the shock machine?

(2 marks)

ii. What is the amplication factor for the test situation?

(3 marks)

iii. What is the Gs, the safe acceleration level for the critical element?

(3 marks)

iv. What is the magnitude of the acceleration experienced by the product in the distribution system?

(3 marks)

v. What is the duration of the shock experienced by the product in the distribution system?

(3 marks)

vi. What is the amplification factor in the distribution system?

(3 marks)

vii. Does the cushion material provide adequate protection for the product?

(3 marks)

Q6 (a) What is the main purpose of the package testing and give definition about product damage.

(5 marks)

(b) In the packaging testing lab the data 45.4 kg product measured 25.4 cm x 25.4 cm x 25.4 cm and can sustain up to a 50 g without damage. It is equally sensitive to shock on all six faces. If a maximum drop height of 152.4 cm is expected in distribution, what is the modulus elasticity of the required cushion material? Assume that the working length of the cushion material is 50% of the cushion's total thickness.

(20 marks)

- END OF QUESTION -

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/2013/2014 PROGRAMME : 3 BNH
COURSE NAME : PACKAGING DYNAMIC COURSE CODE: BNJ 30103

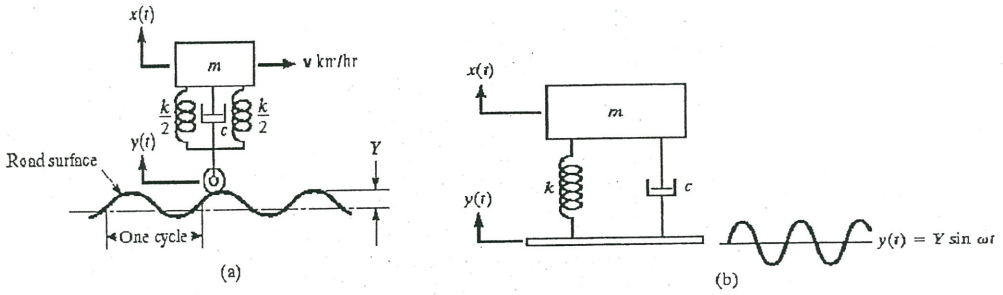

FIGURE Q2

f_1/f_2	A_m	f_1/f_2	A_m	f_1/f_2	A_m	f_1/f_2	A_m	f_1/f_2	A_m	f_1/f_2	A_m
.01	.020	.82	1.397	1.66	1.768	2.50	1.625	3.85	1.300	6.90	1.169
.02	.040	.84	1.419	1.68	1.767	2.52	1.620	3.90	1.289	7.00	1.167
.03	.060	.86	1.441	1.70	1.767	2.54	1.615	3.95	1.279	7.10	1.164
.04	.080	.88	1.462	1.72	1.765	2.56	1.610	4.00	1.268	7.20	1.160
.06	.120	.90	1.482	1.74	1.764	2.58	1.605	4.05	1.258	7.30	1.157
.08	.160	.92	1.501	1.76	1.762	2.60	1.600	4.10	1.247	7.40	1.153
.10	.200	.94	1.520	1.78	1.761	2.62	1.595	4.15	1.237	7.50	1.149
.12	.239	.96	1.538	1.80	1.759	2.64	1.590	4.20	1.227	7.60	1.145
.14	.279	.98	1.555	1.82	1.757	2.66	1.585	4.25	1.217	7.70	1.140
.16	.318	1.00	1.571	1.84	1.755	2.68	1.580	4.30	1.207	7.80	1.135
.18	.357	1.02	1.586	1.86	1.753	2.70	1.575	4.35	1.198	7.90	1.131
.20	.396	1.04	1.601	1.88	1.750	2.72	1.570	4.40	1.188	8.00	1.126
.22	.435	1.06	1.614	1.90	1.747	2.74	1.565	4.45	1.179	8.10	1.120
.24	.474	1.08	1.627	1.92	1.745	2.76	1.560	4.50	1.170	8.20	1.115
.26	.512	1.10	1.640	1.94	1.742	2.78	1.555	4.55	1.160	8.30	1.110
.28	.550	1.12	1.651	1.96	1.739	2.80	1.550	4.60	1.151	8.40	1.104
.30	.588	1.14	1.662	1.98	1.735	2.82	1.545	4.65	1.142	8.50	1.099
.32	.625	1.16	1.672	2.00	1.732	2.84	1.540	4.70	1.133	8.60	1.093
.34	.662	1.18	1.682	2.02	1.729	2.86	1.535	4.75	1.125	8.70	1.087
.36	.698	1.20	1.690	2.04	1.725	2.88	1.530	4.80	1.116	8.80	1.082
.38	.735	1.22	1.699	2.06	1.722	2.90	1.525	4.85	1.108	8.90	1.076
.40	.771	1.24	1.706	2.08	1.718	2.92	1.520	4.90	1.099	9.0	1.070
.42	.806	1.26	1.714	2.10	1.714	2.94	1.515	4.95	1.091	9.1	1.075
.44	.841	1.28	1.720	2.12	1.710	2.96	1.510	5.00	1.083	9.2	1.080
.46	.875	1.30	1.726	2.14	1.706	2.98	1.505	5.10	1.098	9.3	1.085
.48	.909	1.32	1.732	2.16	1.702	3.00	1.500	5.20	1.112	9.4	1.087
.50	.943	1.34	1.737	2.18	1.698	3.05	1.488	5.30	1.124	9.5	1.090
.52	.976	1.36	1.742	2.20	1.694	3.10	1.475	5.40	1.134	9.6	1.092
.54	1.008	1.38	1.746	2.22	1.690	3.15	1.463	5.50	1.143	9.7	1.094
.56	1.040	1.40	1.750	2.24	1.685	3.20	1.451	5.60	1.150	9.8	1.097
.58	1.071	1.42	1.753	2.26	1.681	3.25	1.438	5.70	1.157	9.9	1.098
.60	1.102	1.44	1.757	2.28	1.676	3.30	1.426	5.80	1.162	10.0	1.100
.62	1.132	1.46	1.759	2.30	1.672	3.35	1.414	5.90	1.167	10.1	1.101
.64	1.162	1.48	1.761	2.32	1.667	3.40	1.402	6.0	1.170	10.2	1.102
.66	1.191	1.50	1.763	2.34	1.663	3.45	1.390	6.10	1.172	10.3	1.102
.68	1.219	1.52	1.765	2.36	1.658	3.50	1.379	6.20	1.174	10.4	1.103
.70	1.246	1.54	1.766	2.38	1.654	3.55	1.367	6.30	1.175	10.5	1.103
.72	1.273	1.56	1.767	2.40	1.649	3.60	1.356	6.40	1.176	10.6	1.103
.74	1.299	1.58	1.768	2.42	1.644	3.65	1.344	6.50	1.175	10.7	1.102
.76	1.325	1.60	1.768	2.44	1.639	3.70	1.333	6.60	1.175	10.8	1.102
.78	1.349	1.62	1.769	2.46	1.635	3.75	1.322	6.70	1.173	10.9	1.101
.80	1.373	1.64	1.768	2.48	1.630	3.80	1.311	6.80	1.172	11.0	1.100

TABLE 1 AMPLIFICATION FACTOR (HALF SINE PULSE)