Total No. of Questions : 12] **SEAT No. :**

P1942 **[Total No. of Pages : 6**

[5254]-42
B.E. (Mechanical Engineering)
MECHANICAL SYSTEM DESIGN
(2008 Pattern)

Time : 4 Hours] ***[Max. Marks : 100***

Instructions to the candidates:

1) ***Answer three questions from section I and three questions from section II.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***All questions carry equal marks.***
6) ***Your answers will be valued as a whole.***
7) ***Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam table is allowed.***
8) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Explain the different types of end closures for the pressure vessels? **[6]**

b) A pressure vessel consist of a cylindrical shell with an inner diameter of 1500 mm, and thickness of 20 mm. It is provided with a nozzle with an inner diameter of 250 mm and thickness of 15 mm. The yield strength of the material for the shell and nozzle is 200 N/mm^2 and the design pressure is 2.5 MPa. The extension of the nozzle inside the vessel is 15 mm. The corrosion allowance is 2 mm, while the weld joint efficiency is 0.85. Neglecting the area of welds, determine whether or not a reinforcing pad is requied for the opening. If so, determine the dimensions of pad mode from a plate of 15 mm thickness. **[12]**

OR

Q2) a) What are the methods of pre-stressing the cylinders. **[6]**

b) A hydraulic cylinder, made of gray C.I. FG 300 is subjected to an internal pressure of 15 MPa. If the inner & outer diameter of the cylinder are 200mm & 240mm respectively. Determine the factor of safety. If the cylinder pressure is further increased by 30%, what will be the factor of safety. **[12]**

P.T.O.

Q3) a) What are the desirable properties of cylinder head material? **[4]**

b) The bore of a cylinder of the four - stroke diesel engine is 150 mm. The maximum gas pressure inside the cylinder is limited to 3.5 MPa. The cylinder head is made of grey cast iron FG 200 (Sut = 200 N/mm^2) and the factor of safety is 5. Determine the thickness of the cylinder head.

Studs are used to fix the cylinder head to the cylinder and obtain a leakproof joint. They are made of steel FeE 250 (Syt = 250 N/mm^2) & the factor of safety is 5. Determine : **[12]**

i) Number of studs

ii) Nominal diameter of studs

iii) Pitch of studs

OR

Q4) Design a connecting rod for a high speed I.C. engine using following data.**[16]**

Cylinder bore = 125 mm

Length of connecting rod = 300 mm

Maximum gas pressure = 3.5 MPa

Length of stroke = 125 mm

Mass of reciprocating parts = 1.6 kg

Engine speed = 2200 rpm

Assume suitable data & state the assumptions you make if any.

Q5) a) What are the types of optimum design? Differentiate between them. **[4]**

b) A thin spherical pressure vessel is subjected to an internal pressure of 4N/mm^2. The mass of the empty vessel should not exceed 125 kg. If the factor of safety is 3. Design the pressure vessel with objective of maximizing the gas storage capacity out of following materials. **[12]**

Material	Sut (N/mm^2)	$\rho(kg/m^3)$
Low alloy steel	500	7800
Aluminium alloy	250	2800
Copper alloy	420	8400

OR

Q6) A tensile bar of cross-sectional area atleast 85 mm^2 and length of 200 mm is subjected to a constant load of 5000 N. Design a bar for minimum cost of following materials. Assume factor of safety is 2. **[16]**

Material	Mass density 'ρ' kg/m^3	Material cost 'C' (Rs/N)	Yield strength Syt (MPa)
Steel	7500	16	130
Alluminium alloy	3000	32	50
Magnesium alloy	2100	32	20

SECTION - II

Q7) a) It is observed from a sample of 400 bearings bushes that the internal diameters are normally distributed with mean of 30.015 mm and standard deviation of 0.008mm. Dimension of this diameter specified on drawing is 30.01±0.01mm Calculate the approximate number of rejected bushes from that sample. **[12]**

Refer Table No: 01 for the Areas under normal distribution curve from Z=0 to Z.

b) Justify that the Display and Control elements of a bike are designed based on the ergonomic considerations. **[4]**

OR

Q8) a) Transmission shafts are manufactured on a machining center. The designer has specified the dimension of OD as 30±0.04mm. The natural tolerance is normally distributed with mean of 30mm but only 34% out of the manufactured shafts are found to be acceptable. So what is the standard deviation of this manufacturing process? **[10]**

Refer Table No: 01 above for the Areas under normal distribution curve from Z=0 to Z.

b) Explain the design considerations for Design of Castings. **[6]**

Q9) a) Justify the statement : **'All the structure formulae of the form $N=P_1(S_1).P_2(S_2).....P_n(S_n)$ can not be converted into structure diagrams and hence are not feasible'**. **[4]**

b) Decide the number of teeth of all gears from a 9 speed gearbox with speeds starting from 100 rpm and based on R5, to transmit 10KW power from a motor running at 1440rpm. (Assume that the minimum number of teeth in all stages is 20 and that the design is based on symmetric structure diagram only). **[10]**

Draw the deviation diagram of designed gearbox. **[4]**

OR

Q10)a) With Figure, justify the statement : **'The gap between two fixed gears from a sliding mesh gear box must be greater that two times the face width of those gears'.** **[6]**

b) Draw Symmetric Structure Diagrams for following structure formulae and find out optimum formula out of them along with the justification 3(1)2(3)2(6), 3(2)2(6)2(1), 3(2)2(1)2(6) **[12]**

Q11)a) Explain the following in connection with material handling systems : **[6]**

i) Unit Load

ii) Containerization

iii) Objectives of material handling systems

b) What are the guidelines for the selection of material handling systems.**[4]**

c) A horizontal belt conveyor is to be used for transporting 400 tons of iron ore with mass density 1800kg/m^3 surcharge factor is 0.062. Determine belt width, if belt velocity is 1m/s. **[6]**

OR

Q12) Following data relate to a horizontal belt conveyor used for conveying coal in a thermal power station : **[16]**

Capacity of conveyor: 1200 ton/hr

Density of coal: 700 Kg/ m^3

Belt speed: 1.4 m/s

Surcharge factor: 0.1

Number of plies : 4

Material Factor K 1: 2

Belt tension and contact factor K2: 100

Material conveying length: 355m

Center distance between snub pulleys: 350m

Ratio of tail pulley to drive pulley dia.: 1.0

Ratio of snub pulley to drive pulley dia. : 0.5

Mass of each carrying run idler: 25 kg

Mass of each return run idler: 20 kg

Pitch of carrying run idlers: 1m

Pitch of return run idlers: 2.5m

Friction factor for idlers: 0.02

Snub Factor for snub pulleys: 0.03

Snub factor for Drive and tail pulleys: 0.06

Material velocity component along belt drive: 1 m/s

Angle of lap on drive pulley: 200°

Coefficient of friction between belt and pulley: 0.4

Drive efficiency: 93 %

Mass of belt / mm width / mm length = .015kg/mm/m

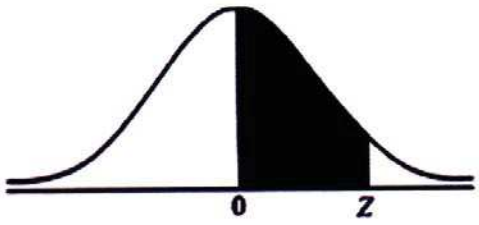
Motor speed 1440 RPM

Determine following parameters of the conveyor:

Standard belt with rounded off to nearest hundred mm.

Reduction ratio of the gear reducer

Power required to drive the conveyor.



Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

Table 01