SEAT No. :

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[5154] - 543

B.E. (Mechanical)

MECHANICAL SYSTEM DESIGN

(2012 Course) (Semester - II) (End Semester) (402048)

Time : 3Hours] *[Max. Marks :70*

Instructions to the candidates:

1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right side indicate full marks.*
4) *Assume suitable data if necessary.*

Q1) a) What are the various laws for stepped regulation of speeds in multi-speed gear boxes? State the advantages and limitations any one of them.**[4]**

b) Define Design Tolerance and Natural Tolerance and explain the difference between them? **[6]**

OR

Q2) a) Explain the following terms with reference to machine tool gear box. How these parameters are decided while designing machine tool drives.**[4]**

   i) Range ratio

   ii) Number of transmission group or stages.

b) A particular type of rolling contact bearing has a normally distributed time to failure with a mean of 10000 hours and a standard deviation of 750h. If there are 100 such bearings fitted at a time, how many May be expected to fail within the first 11000h? **[6]**

z	0	1	2	3	4	5	6	7	8	9
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

Q3) a) Explain on the basis of applications selection between **[4]**

   i) chain conveyor

   ii) screw conveyor

   iii) belt conveyor

b) A three idler troughed belt horizontal conveyor is to be used for transporting 400 ton/hours of iron core having weight density of $1.67*10^{-8}$ KN/mm^3. If the belt speed is 7.2 kmph and surcharge factor is 0.1 calculate the width of belt in mm. **[6]**

<div align="center">OR</div>

Q4) a) Explain the advantages and limitations of troughed conveyors over flat belt conveyor. **[4]**

b) Mr. X is required to transmit the coal from coal storage to boiler house by conveyor. So suggest him suitable type of conveyor and explain the different resistive forces consider to estimate the power requirement for the conveyors. **[6]**

Q5) a) i) What are the objectives of providing openings in pressure vessel. **[4]**

   ii) What is pre stressing of thick cylinder? Explain Auto frettage. **[4]**

b) i) Derive Birnie's equation. Explain under what conditions it is used. **[5]**

   ii) A hydraulic cylinder with closed ends is subjected to an internal pressure of 15MPa. The inner and outer diameter of the cylinder is 200mm and 240mm respectively. The cylinder material is cast iron FG300. Determine the factor of safety used in design. If the cylinder pressure is further increased by 50%. What will be the factor of safety. **[5]**

<div align="center">OR</div>

Q6) a) i) What are types of end closure for cylindrical vessel? State the design procedure of hemispherical head. **[4]**

   ii) Explain the various categories of the welded joints used in unfired pressure vessel. **[4]**

b) A hydraulic control for a straight line motion as shown in fig. utilizes a spherical pressure tank A connected to a working cylinder B. The pump maintains a pressure of 3 MPa in the tank. **[10]**

i) If the diameter of pressure tank is 800 mm, determine its thickness for 100% efficiency of the joint. Assume the allowable tensile stress as 50 MPa.

ii) Determine the diameter of a cast iron cylinder and its thickness to produce an operating force F = 25 KN. Assume

1) an allowance of 10% of operating force F for friction in the cylinder and packing and

2) a pressure drop of 0.2 MPa between the tank and cylinder. Take safe stress for cast iron as 30 MPa.

iii) Determine the power output of the cylinder if the stroke of the piston is 450mm and time required for the working stroke is 5 seconds.

iv) Find the power of the motor if the working cycle repeats after every 30 seconds and the efficiency of the hydraulic control is 80% and that of 60%.
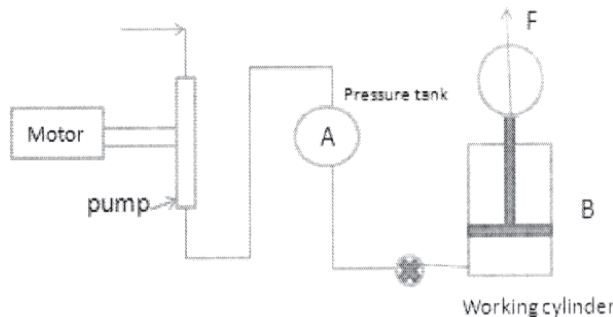
Q7) a) i) What is the funciton of the cup on the piston head? **[3]**

ii) Why are more number of thin piston rings preferred over small number of thick rings? **[3]**

b) The following data is given for the piston of a four stroke diesel engine: Cylinder bore 0.25 m, maximum pressure = 4MN/m², Bearing pressure at small end of connecting rod = 15 MN/m², Length of piston pin in bush of small end = 0.45D, inner diameter of piston pin is 0.6 times outer diameter of piston pin and mean diameter of piston boss is 1.4 times outer diameter of piston pin, Allowable bending stress for piston pin = 84 MPa. Calculate: **[10]**

    i)   outer and inner diameter of the piston pin

    ii)   mean diameter of the piston boss

    iii)   check the design for bending stress

<div align="center">OR</div>

Q8) a) i)   Why are connecting rod made of I sections?   **[3]**

    ii)   Why do inlet and exhaust valves have conical heads and seats?**[3]**

b) The following data is given for the cap and bolts of the big end of the connecting rod: **[10]**

Engine speed = 1500 rpm

Length of connecting rod = 0.320 m

Length of stroke = 0.140 m

Mass of reciprocating parts = 1.75Kg

Length of crank pin = 54 mm

Diameter of crank pin = 38 mm

Permissible tensile stress for bolts = 120MN/m²

Calculate the nominal diameter of bolts and thickness of cap for the big end.

Q9) a) What is design for manufacture? Explain the general principles to be followed while designing the parts of manufacture. **[6]**

b) A shaft is required to transmit 100KW at 1000 rpm and torsional stiffness of the shaft is 90N.m/ degree. Design the shaft using maximum shear stress theory of minimum weight. Material properties are given below. Also find out diameter and length of shaft for the same. Assume factor of safety is 1.5 and combined shock and fatigue load factor = 1.5. **[10]**

Material	Density Kg/m³	Tensile strength MN/m²	Modulus of Rigidity MN/m²
M1	7800	450	82000
M2	2800	150	27000
M3	1800	100	17000

OR

Q10) a) What is design for safety? Explain the general principles to be followed while designing the product for safety? **[6]**

b) A tensile rod of diameter 'd' having length 0.6 m is subjected to a tensile force 5 KN. Calculate the rod diameter with the objective of minimizing the weight of material. Assume factor of safety 2. Use following table. **[10]**

Material	Density Kg/m³	Syt in N/m²	Modulus of Rigidity MN/m²	Material cost Rs./Kg
Steel	7800	400*10⁶	82000	14
Aluminium Alloy	2800	150*10⁶	27000	70
Titanium Alloy	4500	800*10⁶	41000	1100

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