5. a) What is Optimization? State its application in engineering. What do you understand by "Optimum design" and "Adequate design"? 4

   b) Explain giving example the following terms used in optimization : 10

   i) Design Vector

   ii) Design Constraints

   iii) Objective function

OR

A total length of 400 m of tubes must be installed in a heat exchanger to provide the essential heat transfer surface area. The total cost of installation includes :

i) Cost of tubes = Rs. 25,000

ii) Cost of heat exchanger shell = $30 D^{2.5}L$

iii) Cost of floor space occupied by the heat exchanger = Rs. 10 DL.

The spacing of tube is in such a manner that 25 tubes will fit in a cross-sectional area of 1 m² inside the shell; determine the diameter D and length L of heat exchanger to minimize the purchase cost. 10

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Roll No ....

ME-802

B.E. VIII Semester

Examination, June 2016

Machine Design

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt all questions.

ii) In each question there are two parts A and B. B has internal choice.

iii) Use of Design Data Book is permitted.

1. a) Discuss, how chain and wire ropes are designated? 4

   b) Design completely belt drive to drive a winch from an electric motor of 11 kW power. Speed of motor shaft is 750 rev/min. Speed ratio is 4. Belt position is horizontal and there is considerable variation of load. 10

OR

Design a chain drive to actuate a compressor, from 15 kW electric motor running at 1000 rpm, the compressor speed being 350 rpm. The minimum centre distance is 500 mm. The compressor operates 16 hours per day. The chain tension may be adjusted by shifting the motor on slides. 10

2 a) Define terms "Tooth error in action" and "Stalling load" for gears. 4

b) A pair of bevel gears connects two shafts at right angles and transmits 9 kW. Determine the required module and gear diameters for following specifications : 10

Particulars	Pinion	Gear
Number of Teeth	21	60
Material	Semi Steel ($Ep = 210$ kN/mm^2)	Grey CI ($Eg = 84$ kN/mm^2)
BHN	200	160
Allowable static stress	85 MPa	55 MPa
Speed	1200	420
Tooth Profile	14½° composite	14½° composite

OR

Write short notes on : 10

i) Causes and effect of dynamic load on Gears.

ii) Different modes of gear tooth failure.

iii) Design of arms and shaft for helical gears.

3. a) What are different types of liners used in IC Engine cylinder? 4

b) What do you understand by Whipping Stresses in IC Engine connecting rod? Explain in brief. 10

OR

Design a plain carbon steel centre crank shaft for a single acting four stroke single cylinder engine for the following data :

Bore = 400 mm, Stroke = 600mm, Engine speed = 200 rpm, Mean effective pressure = 0.5 N/mm^2, Maximum combustion pressure = 2.5 N/mm^2, Weight of flywheel used as a pulley = 50 kN, Total belt pull = 6.5 kN.

When the crank has turned through 35° from the TDC, the pressure on the piston is 1 N/mm^2 and the torque on the crank is maximum. The ratio of the connecting rod length to the crank radius is 5.0. Assume any other data required for the design. 10

4. a) Differentiate between a muff and a clamp coupling. State under what conditions, pin type flexible couplings are used. 4

b) Design a suitable coupling for connecting a motor and a pump shaft. The power to be transmitted is 12 kW at 1000 rpm. Due to poor workmanship a slight misalignment (Angular up to 0.5° and / or parallel up to 0.25 mm) of the driver and driven shafts may be possible. Assume allowable bearing pressure in rubber bush as 0.5 N/mm^2. 10

OR

A closed ended cast iron cylinder of 200 mm diameter is to carry an internal pressure of 10 N/mm^2 with a permissible stress of 18 MPa. Determine the wall thickness by using Lame's equation and Max. Shear stress equations. Which theory gives more accurate answer? 10