R.M

INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Date:_____FN/AN, Time: 2 Hrs., Full Marks: 30, Deptt: Rajendra Mishra School of Engineering Entrepreneurship, No. of Students: 130, Mid Spring Semester Examination, Sub. No. EP60042, Sub Name: Engineering Design Process, _____Yr. B.Tech.(H) / B.Arch.(H) / M.Sc. / M.Tech(Dual)

Instruction: Please write in brief and to the point.

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1. a) "QFD is an important step in Engineering Design" – Explain.
   b) Five possible 'Technical Descriptors' are to be considered at secondary level - two in 'material' sub-head and three in 'process' sub-head under two primary level grouping, in developing a product chosen by you. Description of four 'Customer Requirements' at the secondary level comprising two each under two primary level groupings for the same are also to be considered based on a survey for the above product in a standard QFD template. Numerical values as 6, 7, 4 and 8 in a scale of 1 to 10, arranged from top to bottom, as column vector, signifies importance of Customer Requirements. The corresponding 'Scale-Up Factor' as 1.3, 1, 1 and 1.3; and the' Sales Point' as 1.5, 2, 1, and 1 may also be considered. Values as 9, 3 and 1 may be assigned for symbols for 'Strong', 'Medium' and 'Weak' respectively in the inter-relationship matrix, applicable according to your consideration. (i) Construct the HoQ diagram including the inter-relationship among Technical Descriptors, assuming data as required and (ii) determine the Relative Weights of the Technical Descriptors as row vector, showing detailed computation for the first column.
   c) Expound RPN in Design FMEA [Marks: 2+ (5+4)+2 = 13]

2. a) Illustrate the steps involved in Engineering Design Process.
   b) Describe 'Alpha' and 'Beta' prototyping, with an example.
   c) Exemplify 'Product Architecture' with reference to household electric fans [Marks: 2+2+2 = 6]

3. a) Elucidate the consideration of Process capability in engineering design. (b) Compute Cpm and Cpkm, considering a design characteristic with target of 100μ and upper and lower specifications limit of 104μ and 96μ. The process average (μ) is 99.6 and the standard deviation is 1.02. [Marks: 1+ 2=3]

4. The following is the description of an engineering product, having three designed components P, Q and R in series. P has a reliability value of 0.75 and cost as Rs.2000/-; Q has a reliability value of 0.92 and cost as Rs.4000/- and R has a reliability value of 0.89 and cost as Rs.6000/-. The current selling price of the product is Rs. 14000/-. A proposal of redesigning P as P' is under consideration to upgrade the reliability of the component to 0.81 and the corresponding cost will be Rs 3000/-. P or P' as single component or in parallel combinations can be configured in the design to improve product reliability. The packaging, however, does not allow more than two of the same components or its variants. Therefore, besides P or P' singly, any of the combinations, P and P; P and P'; P' and P' only can be designed. Recommend the most profitable design, if the selling prices are Rs. 16000/-, Rs. 18000/- and Rs. 21000/- corresponding to the reliability value-ranges as 0.65-0.75, above 0.75- 0.78 and above 0.78. [Marks: 4]

5. Consider a product in engineering manufacturing, where (i) material, (ii) labour and manpower and (iii) overhead costs are in the order of 60%, 10% and 20% respectively. The resultant profit is 10%. Design improvement in product features helps to add a premium of 6% to the price. The sales volume also, due to such improvement, goes up by 7%. Elucidate with a numerical example, (a) the impact of design improvement on profit due to the above. Further, (b) show as to how the profit is impacted with a material cost reduction, through value engineering in design, to the tune of 5%. [Marks: 3+1=4]