K. K. Wagh Institute of Engineering Education & Research, Nashik

(An Autonomous Institute From A.Y. 2022-23)

WINTER-2025	
Exam Seat No.:	
Academic Year:2025-2026	Semester:VII
Class:FINAL	Program:B.Tech
Branch Code:MEC	Pattern:2022
Name of Course:Engineering System Design and Optimization	Course Code:MEC224001
Max. Marks:60	Duration:2.30 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 02 page(s).
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

		Marks	CO
Question No. 1			
1a)	Define and explain the following terms with suitable examples: 1. Population, 2. Sample, 3. Random Variable Additionally, discuss the concept of Reliability-Based Design with a clear explanation.	(6)	CO1
Question No. 2			
2a)	A machine tool requires 12 speed in the range n_{max}=1000 r.p.m. ton_{min} =180 r.p.m. List the most suitable speeds to be provided.	(6)	CO2
Question No. 3			
3a)	For the connecting rod of a diesel engine, calculate the dimensions of the small end and big end bearings. Following data : Bore Diameter = 100 mm, Maximum gas pressure = 30 N/mm², (l/d) ratio for piston pin bearing = 1.5 (l/d) ratio for crank pin bearing = 1.3, Allowable bearing pressure for piston pin bearing = 15 MPa Allowable bearing pressure for crank pin bearing = 12 MPa	(8)	CO3
	OR		
3b)	Explain with neat sketches procedure for design of center crankshaft at top dead center position.	(8)	CO3
3c)	The following data is given for the piston of a four-stroke diesel engine: Cylinder bore = 100 mm, Maximum gas pressure = 4.5 MPa, Bearing Pressure at small end of connecting rod = 20 MPa, Length of piston pin in bush of small end = 0.45 D, Mean diameter of piston boss = 1.4 Outer diameter of piston pin, Allowable bending stress for piston pin = 140 N/mm². Calculate: (i) Outer diameter of piston pin (ii) inner diameter of piston pin (iii) mean diameter of piston boss; and (iv) check the design for bending stress.	(8)	CO3
	OR		
3d)	Explain with sketch construction of piston and What are the desirable properties of I. C. Engine piston materials? State the material used for I. C. engine piston.	(8)	CO3
Question No. 4			
4a)	Write a detailed note on Taguchi optimization technique and its application in engineering domain	(8)	CO4

OR

4b) Write a detailed note on Genetic algorithm optimization technique and its application in engineering domain. (8) CO4

4c) Write a detailed note on Ant Colony optimization technique and its application in engineering domain. (8) CO4

OR

4d) Write a detailed note on Fuzzy optimization technique and its application in engineering domain. (8) CO4

Question No. 5

5a) a) A tensile bar of length 400 mm is subjected to constant tensile force of 4000 N. If the factor of safety is 2, design the bar with the objective of minimizing the material cost using optimum material from the list given below. (8) CO4

Material	Density (ρ) (kg/m^3)	Cost (c) (Rs/kg)	S_{yt} (Mpa)	G N/mm^2
Steel	7800	14	400	82000
Aluminium Alloy	2800	70	150	27000
Titanium Alloy	4500	1100	800	41000

OR

5b) Explain the classifications of design parameters with design equation in detail. (8) CO4

5c) c) Design a tensile bar of length 300 mm having a square cross section to carry a tensile load of 3 KN for Minimum cost out of the following materials. Consider the factor of safety as unity. (8) CO4

Material	Density (ρ) (kg/m^3)	Cost (c) (Rs/N)	Yield Strength (MPa)
Steel	7500	16	130
Aluminium Alloy	3000	32	50
Titanium Alloy	4800	480	90
Magnesium Alloy	2100	32	20

OR

5d) Explain the Johnsons method of optimum design and also discuss about adequate design with suitable example. (8) CO4

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