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MECHANICAL ENGINEERING

PAPER - I
SECTION A

1. Answer any four of the following (each answer should conform to a limit of around 150 words).

(a) Mention the conditions required for a two mass system to be dynamically equivalent to a rigid mechanical component. Why sometimes is a hypothetical correction couple applied on the two mass system to make it dynamically equivalent to a rigid body? Find the position of centre of percussion of a compound pendulum from its centre of gravity. What is the significance of the concept of centre of percussion for a batsman playing a cricket? (6 + 4 = 10)

(b) What is meant by hunting of governor? Explain briefly the causes of its occurrence. Justify with reasons, whether it is more severe in case of unbalanced governor or isochronous governor (10)

(c) (i) A connecting rod in I.C. engine is designed as a column, with an I-section. Designers take moment of inertia of the cross-section about one axis equal to 4 times that taken about the perpendicular axis. Why? (6 + 4 = 10)

(ii) Why is it considered that the hollow shaft under torsion is lighter than a solid one, if other parameters are the same?

(d) (i) Draw a Mohr's circle of stress for a round bar which is shrunk fit by a hub, with brief explanation. (5 + 5 = 10)

(ii) A cantilever is loaded and the bending moment diagram is rectangular as shown in Figure. What will be the shape of the shear force diagram? (5 + 5 = 10)

(e) With reference to figure, neglect the weight of the bar and stopper. A load W is dropped from a height h . Given $W = 1.0 \text{ kN}$, area of cross- section of the bar = 20 mm^2 . Find the instant tensile stress developed in the bar when the weight W is dropped from a height $h = 0$. (10)

2. (a) A machine weighing 68 N is mounted on a set of springs, whose equivalent spring stiffness, $K = 1070 \text{ N/cm}$ and damping factor, $\xi = 0.2$ arranged vertically on a rigid foundation. A piston within the machine weighing 2.0 N has a vertical reciprocating motion, with a stroke of 8.0 cm and a crank shaft with a speed of 3000 rpm. Assuming the motion to be simple harmonic, determine:

(i) The amplitude of vibration in the vertical direction of the machine. (5)

(ii) The transmissibility ratio and the force transmitted to the foundation. The phase lag between the transmitted force and the exciting force. (5)

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Python Institute Certified Associate Data Analyst with Python (PCAD-31-02) Sample Questions (Q102-Q107):

NEW QUESTION # 102

Which actions are considered best practices when managing datasets in Python using pandas?
(Choose two)

- A. Always convert all columns to strings
- B. Replace missing values with hardcoded zeros without analysis
- C. Use `.info()` to understand dataset structure
- D. Use `.describe()` for summary statistics

Answer: C,D

NEW QUESTION # 103

What is the primary reason to use `.head()` and `.tail()` methods in pandas when exploring datasets?

- A. To preview the first and last few rows of data
- B. To rename columns
- C. To create visualizations
- D. To delete missing values

Answer: A

NEW QUESTION # 104

Which file format is most suitable for exchanging large tabular datasets with consistent column data types across systems?

- A. `.txt`
- B. `.xml`
- C. `.json`
- D. `.csv`

Answer: D

NEW QUESTION # 105

What is the primary purpose of using a `requirements.txt` file in Python-based data projects?

- A. To track script runtime dependencies during execution
- B. To list the packages and versions required for consistent environment setup
- C. To store the current working directory of Python modules
- D. To automatically compress source code for deployment

Answer: B

NEW QUESTION # 106

Which practices enhance both readability and professionalism in spreadsheet formatting?
(Choose two)

- A. Applying consistent font and cell styling
- B. Using uniform date formats across columns
- C. Aligning column headers to the left
- D. Centering all data regardless of type

Answer: A,B

NEW QUESTION # 107

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