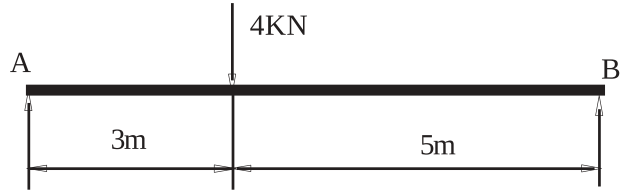
7. (a) Using the principle of virtual work, determine the reactions of a beam AB of span 8m. The beam carries a point load of 4KN at a distance of 3m from A. 30



(b) Explain Ackermann Steering Gear with a neat sketch and also three positions of the correct gearing. 30

8. (a) Solve the following linear program model. Show steps.

$$\text{Maximize } z = 2x_1 + 3x_2 + 5x_3$$

$$\text{Subject to } \quad x_1 + x_2 - x_3 \geq -5$$

$$-6x_1 + 7x_2 - 9x_3 \leq 4$$

$$x_1 + x_2 + 4x_3 = 10$$

$$x_1, x_2 \geq 0$$

30

(b) What is Regression Analysis ? Explain with a simple example. 30

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Mechanical Engineering

(16)

Paper—I

Time : Three Hours] [Maximum Marks : 300

Note :— (i) Answers must be written in English.

(ii) The number of marks carried by each question are indicated at the end of the question.

(iii) Part/Parts of the same question must be answered together and must not be interposed between answers to other questions.

(iv) The answer to each question or Part thereof should begin on a fresh page.

(v) Your answers should be precise and coherent.

(vi) Candidates should attempt Question Nos. **1** and **5** which are compulsory and any **three** out of the remaining questions, selecting at least **one** question from each Section.

(vii) If you encounter any typographical error, please read it as it appears in the text-book.

SECTION–A

1. Answer any **three** of the following :

(a) What is meant by interference in involute gears ? Explain. 20

(b) What are centripetal and tangential components of acceleration ? When do they occur ? How are they determined ? 20

(c) What are the different types of Damping ? Explain in brief. 20

(d) State and explain Castigliano's theorem. 20

2. (a) How the gap between the tool and work piece is maintained at the pre determined level in EDM ? Explain. 20

(b) What are the limitations of Laserbeam machining ? Explain with suitable diagram. 20

(c) Explain the process of metal removal rate in USM (Ultra Sonic Machining). 20

3. (a) Describe the function of a simple watt governor. What are its limitations ? 15

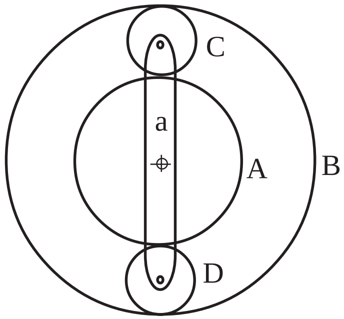
(b) Explain the processes of material removal in ECM with the help of suitable diagram. 30

(c) What is "GYROSCOPE" ? What is the harm if gyroscopic effect is not considered in vehicles/machines ? 15

4. (a) An Epicyclic gear train is shown in Figure below. The number of teeth on A and B are 80 and 200. Determine the speed of the arm 'a' :

(i) if 'A' rotates at 100 rpm clockwise and B at 50 rpm counter clockwise.

(ii) if 'A' rotates at 100 rpm clockwise and B is stationary. 30



(b) A single plate clutch is required to transmit 8 KW at 1000 rpm. The axial pressure is limited to 70 KN/m^2. The mean radius of the plate is 4.5 times the radial width of the friction surface. If boths the sides of the plate are effective and the coefficient of friction is 0.25.

Find :

(i) the inner and outer radii of the plate and the mean radius.

(ii) the width of the friction lining. 30

SECTION–B

5. Answer any **three** of the following :

(a) List different methods of line balancing. Explain Heuristic method of line balancing with the help of suitable example. 20

(b) Explain the concept of economic order quantity. Give assumptions and derive the formula. 20

(c) What are the procedural steps involved in ABC analysis of Inventory ? Explain. 20

(d) Explain the process of metal removal rate in EDM with the help of suitable diagram. 20

6. (a) At a point in a stressed body the normal stresses are 83N/mm^2 (tensile) on a vertical plane and 27.5N/mm^2 (compressive) on a horizontal plane. A shear stress of 41.4 N/mm^2 acts at this point. Determine and show on a sketch the principal stresses and the maximum shearing stress at this point using Mohr's circle. 30

(b) The Figure below shows an over hanging beam. The part of the beam between the supports carries a uniform distributed load (UDL) (W) and the free end of over hang carries an anti-clockwise couple equal to $\frac{WL^2}{5}$. Calculate the maximum deflection. Assume EI constant. 30