

1[CCE.M]1

Mechanical Engineering–I

(16)

Time : Three Hours

Maximum Marks : 300

INSTRUCTIONS

- (i) Answers must be written in English.
- (ii) The number of marks carried by each question is indicated at the end of the question.
- (iii) The answer to each question or part thereof should begin on a fresh page.
- (iv) Your answers should be precise and coherent.
- (v) The part/parts of the same question must be answered together and should not be interposed between answers to other questions.
- (vi) Candidates should attempt question nos. **1** and **5** which are compulsory and any **three** more 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.

machine M_1 is 104 hours and that of Machine M_2 is 76 Hours.
 Profit per unit for product A is Rs. 6 and that of B is Rs. 11.

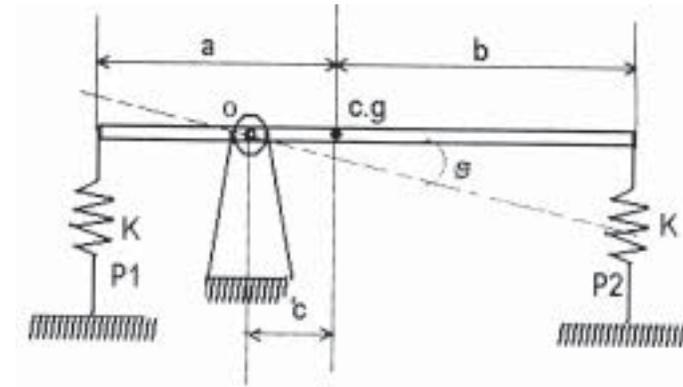
- (i) Formulate the problem
- (ii) Find out the optimal solution by simplex method. 50

7. (a) A company has three plants A, B and C and three warehouses P, Q and R. The Transportation cost per unit demand of each ware house and capacity of each plant are as given in the table below. Find the optimum transportation plan using Vogel's Approximation Method.

Plant	Ware House			Capacity
	Transportation Cost in Rs.			
	P	Q	R	
A	50	80	100	400
B	22	90	40	500
C	70	100	55	300
Demand	400	400	400	1200

(b) Arrivals at a telephone booth are considered to be Poisson with an average time of 10 minutes between one arrival and the next.

in the equilibrium position with spring forces P_1 and P_2 . Determine the equation of motion and the natural frequency. 25

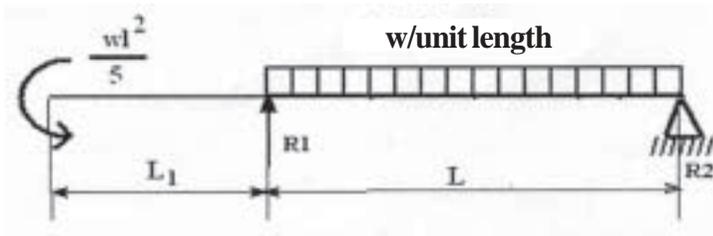


(d) Describe any two inversions of slider-crank mechanism. 25

2. (a) A Hooke's joint is to connect to shafts whose axes intersect at 150° . The driving shaft rotates uniformly at 120 rpm. The driven shaft operates against a steady torque of 150 Nm and carries a fly wheel whose mass is 45 kg and radius of gyration 15 cm. What is the maximum value of the torque which must be exerted by the driving shaft ?

(b) Derive the Lamé's equation and determine the radial and tangential stresses of a thick cylinder pressurized from inside and outside. 50

3. (a) Give the classification of Governors and explain the working principle of Hartung Governor with a neat sketch.
- (b) A reciprocating pump 200 kg is driven through a belt by electric motor at 3000 rpm. The pump is mounted on isolators with total stiffness 5 M N/m and damping 3.125 kNs/m. Determine the vibratory amplitude of the pump at the running speed due to the fundamental harmonic force of excitation 1 kN. 50
4. (a) The figure shows an over hang beam. The part of the beam between the supports carries a UDL, "w" and the free end of over hang carries an anti-clock wise couple equal to $wl^2/5$. Calculate the maximum deflection. Assume EI is Constant.



- (b) At a point in a stressed body there are normal stresses of 1 N/mm² (tensile) on a vertical plane and 0.5N/mm² (tensile) on a horizontal plane. The shearing stresses on these planes are zero. Determine the normal and shearing stresses on a plane making an angle of 50° with the vertical plane. 50

SECTION-B

5. Answer any **three** of the following :
- (a) Classify Non Traditional Machining Methods. Explain briefly. 25
- (b) What are the factors governing a good work station design ? 25
- (c) Explain the principle and procedure of work sampling. 25
- (d) How do you determine Economic Order Quantity for inventory model with uniform demand ? 25
6. (a) Consider the following linear programming :

$$\text{Max. } Z = 11x_1 + 4x_2$$

$$\text{Subject to } 7x_1 + 6x_2 \leq 84$$

$$4x_1 + 2x_2 \leq 32$$

$$x_1, x_2 \geq 0.$$

Solve the above problem graphically.

- (b) A company is manufacturing two different types of products A and B. Each product has to be processed on two machines M₁ and M₂. Product A requires 2 hours on machine M₁ and 1 hour on machine M₂, product B requires 1 hour on machine M₁ and 2 hours on machine M₂. The available capacity of

- (viii) Candidates are in their own interest advised to go through the General Instructions on the back side of the title page of the Answer Script for strict adherence.
- (ix) No continuation sheets shall be provided to any candidate under any circumstances.
- (x) Candidates shall put a cross (X) on blank pages of Answer Script.
- (xi) No blank page be left in between answer to various questions.

SECTION–A

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

- (a) What is a cam ? How are the cams classified ? Describe in detail. 25
- (b) What is Instantaneous Center of Rotation ? How do you know the number of Instantaneous Centers in a mechanism ? What are different types of Instantaneous centres ? State Arnold–Kennedy Theorem. 25
- (c) The Figure shows a uniform bar pivoted about point "O" with springs of equal stiffness K at each end. The bar is horizontal

The length of the phone calls is assumed to be distributed exponentially with a mean of 3 minutes.

- (i) What is the probability that a person arriving at the booth will have to wait ?
- (ii) What is the average length of the queue that is formed from time to time ?
- (iii) The telephone company will install a second booth when convinced that an arrival would have to wait at least three minutes for the phone to be free. By how much will the flow of arrivals be increased in order to justify a second booth ? 50

- 8. (a) What are the different types of extrusion process ? Explain with neat sketches.
- (b) A pipe of Annealed steel, inside diameter of 50 mm and wall thickness of 2.5 mm is to be reduced down to 48.7 mm \times 1.75 mm. Die angle is 30°; $\mu = 0.1$ and draft = 3.12. Compare the pipe drawing force on plug and moving mandrels. 50