

(3 Hours)

[Total marks: 80]

Instructions:

1. **Question 1 compulsory.**
2. Attempt any **three** questions from the remaining **five** questions.
3. Figures to the right indicate full marks.
4. Assume suitable data wherever required but justify the same.

- Q.1.** Solve ANY FOUR questions from following.
- |   |                                                                                               |           |
|---|-----------------------------------------------------------------------------------------------|-----------|
| a | List four levels of automation with suitable examples                                         | <b>05</b> |
| b | Explain backpropagation algorithm used in Artificial Neural Networks.                         | <b>05</b> |
| c | Define Continuous path control system used in robotic system with suitable applications.      | <b>05</b> |
| d | Summarize with a schematic block diagram, an automated system showing all the basic elements. | <b>05</b> |
| e | Explain the concept of Timers and Counters used in PLC architecture.                          | <b>05</b> |
- Q.2.**
- |    |                                                                                                                                                                     |           |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| a. | Design an electro- pneumatic circuit for two-cylinder operation with following sequence using 5/2 both side solenoid operated valve as DCV.<br>A+ , Delay B+ , A-B- | <b>10</b> |
| b. | Illustrate with neat diagram counter balance valve and Bleed off hydraulic circuits used in hydraulic system.                                                       | <b>10</b> |
- Q.3.**
- |    |                                                                                                                       |           |
|----|-----------------------------------------------------------------------------------------------------------------------|-----------|
| a. | Illustrate with neat sketches any three types of drives used in robotic system with its advantages and disadvantages. | <b>10</b> |
| b. | Illustrate Goal based reflex agents and Model based intelligent agents in AI with examples.                           | <b>10</b> |
- Q.4**
- |    |                                                                                                                                                                    |           |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| a. | Design a hydraulic circuit for two cylinder operation with following sequence using 4/2 pilot operated valve as DCV using cascade method , A+ , B+ , Delay B- , A- | <b>08</b> |
| b. | Differentiate between supervised and unsupervised techniques used in machine learning.                                                                             | <b>07</b> |
| c. | Define the terms Robot Degrees of freedom for robotic system.                                                                                                      | <b>05</b> |
- Q.5.**
- |    |                                                                                                        |           |
|----|--------------------------------------------------------------------------------------------------------|-----------|
| a. | Explain the significance of latching in PLC.                                                           | <b>06</b> |
| b. | Illustrate K nearest neighbours algorithm used in machine learning.                                    | <b>08</b> |
| c. | Illustrate with neat sketches, the logic of AND and OR gates, used in operation of pneumatic circuits. | <b>06</b> |
- Q.6**
- |    |                                                                       |           |
|----|-----------------------------------------------------------------------|-----------|
| a. | Differentiate between tree and graph search used in Machine Learning. | <b>08</b> |
| b. | Illustrate the concept of Logistic regression in machine learning.    | <b>06</b> |
| c. | Illustrate the concept of Artificial Neural Networks (AAN) in detail. | <b>06</b> |

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3 Hours

(80 Marks)

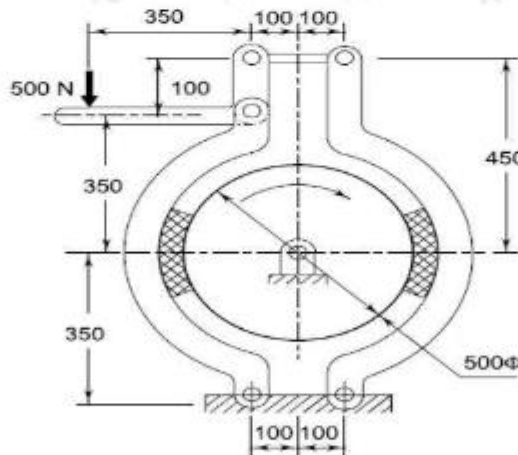
- N.B.:
- (1) All questions carry equal marks.
  - (2) Question No.1 Compulsory.
  - (3) Attempt any three from remaining five questions.
  - (3) Figures to the right indicate full marks.
  - (4) Draw neat sketches wherever necessary.
  - (5) Assume suitable data wherever necessary.

1. Write short notes on the following. (Any four) (20)

- a) Explain the Ackerman principle of steering with neat sketch.
- b) Explain front engine front wheel drive's salient features, advantage and disadvantages.
- c) Explain Working of differential with neat sketch.
- d) Explain the working of shock absorber with neat sketch.
- e) Explain the construction of various frames used in automobiles with neat sketch.
- f) Explain the pneumatic or air brakes with neat sketch.

2. a) A double block brake is shown in Figure. The brake drum rotates in a clockwise direction and the actuating force is 500N. The coefficient of friction between blocks and the drum is 0.35.

Calculate the torque absorbing capacity of the brake. (10)



b). Explain the construction of sliding mesh gearbox with suitable figure. (10)

3. a) The following data is given for a connecting rod:

- Engine speed = 3000rpm Thickness of bearing bush = 4mm  
 Material of Cap = steel 40C8 Yield Strength of cap material =  $380\text{N/mm}^2$   
 Factor of safety for cap = 4 Material Of bolts = Chromium Molybdenum Steel  
 Yield Strength of bolt material =  $450\text{ N/mm}^2$  Factor of safety for bolt = 4.5  
 Density of connecting rod =  $7800\text{ kg/mm}^3$

(10)

- b) Briefly describe construction and working of disc brakes. Compare them with the conventional drum brakes. (10)
4. a) State the function of piston with its design consideration. Which materials are used for making of piston and how their properties affect piston design? Write down the steps in piston design. (10)
- b) An engine develops 29.5 kW at 2000 rpm when the torque is maximum. The bottom gear ratio is 3:1 and the back axle reduction is 4.5:1. The load on each driving axle is 7357.5 N when the car is fully loaded. Diameter of road wheel over the tyres, is 0.71 m and the coefficient of adhesion between tyre and road is 0.6. If the permissible stress in the material of the shaft is not allowed to exceed  $22072.5 \times 10^4$  Pa, find the diameter of the axle shaft. (10)
5. a) An automotive gear box gives three forward speeds and one reverse with a top gear of unity and bottom and reverse gear ratio of approximately 3.3:1. The centre distance between the shafts is to be 110 mm approximately. Gear teeth of module 3.25mm are to be employed. Sketch the layout of a typical constant mesh gear box for these conditions giving the number of teeth for the various gear wheels and showing closely how the different ratios are obtained. (10)
- b) Explain the working of rear independent suspension system with neat sketch and compare with dependent suspension system. (10)
- Q 6) Write short note on (Any Four) (20)
- a) Transfer case.
  - b) Centrifugal clutch
  - c) Torque tube drive
  - d) Brake lining material
  - e) Different layouts of vehicle construction
  - f) Types of road wheels.
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Duration: 3 Hours

Total Marks: 80

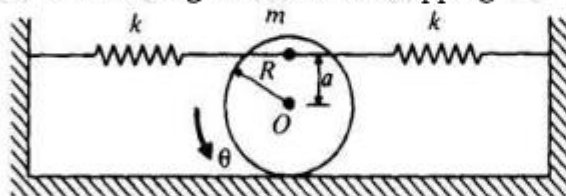
**Instructions :**

- [1] Question No.1 is compulsory.
- [2] Answer any three from the remaining five questions.
- [3] Assume suitable data whenever required with proper justification.
- [4] Answers to questions should be grouped and written together.
- [5] Figures to the right indicate full marks.

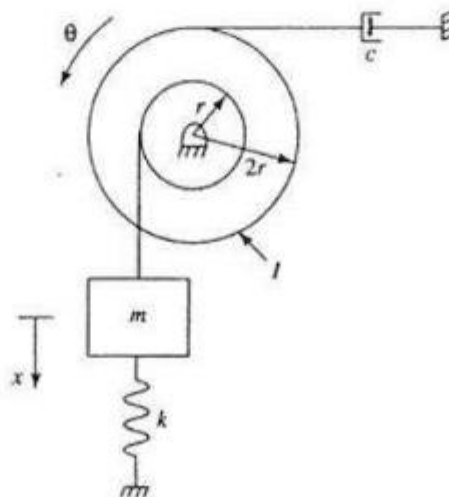
**Q.1 Attempt any four of the following. All sub-questions carry equal marks 20**

- (a) Write a short note on Rayleigh's method.
- (b) Explain what you mean by the term 'Critical Speed' of rotating shaft? Derive necessary formulae for undamped system.
- (c) A viscously damped spring mass-damper systems has mass of 10 kg, damping coefficient of 150 N-s/m, and spring stiffness of 1000 N/m. Determine the values of the damping ratio, damped natural frequency and logarithmic decrement
- (d) Draw a plot of Magnification Factor versus Frequency Ratio curves for various damping factor values. Write the expression consisting of the three parameters. State the conclusions that may be drawn from the plot
- (e) A rotating unbalance system consists of a disc of mass 2 kg, which is eccentric to the axis of the shaft by 2 mm. Adding two counter masses of 1 kg, each at an axial distance of 1 cm and 2 cm respectively from either side of the disc, the system is completely balanced. Find the radial location of the counter masses if all the masses lie in the same axial plane.
- (f) Write and explains the various steps involved in the vibration analysis

**Q.2 (a) Find the natural frequency of oscillation of homogeneous cylinder having mass 'm' which rolls on ground without slipping 10**



- (b) Determine the parameters for an equivalent systems model for the system shown in fig. using  $x$ , the downward displacement of the block from the system's equilibrium position, as the generalized coordinate.



- Q.3 (a)** Explain the balancing of V-engine **10**
- (b)** A machine of mass 50 kg operates at 1200 rpm. Find the maximum stiffness of an isolator that provides 75 percent isolation. Assume that damping ratio of the isolator is 7 percent **10**
- Q.4 (a)** 30 N at 20 cm, 20 N at 40 cm, 10 N at 60 cm from fixed end are the loading on a cantilever. The deflection under 10 N due to all loads is 2mm. Find the natural frequency of oscillation of the system using Dunkerly's and Rayleigh's methods. The deflection at section i due to unit load at section j is given by, **15**
- $$U_{ij} = \frac{S_i^2}{\text{constant}} (3S_j - S_i) \text{ for } S_i \geq S_j$$
- $U_{ij} = U_{ji}$ , 'S' is the distance from fixed end
- (b)** Show that the inertia effect of a shaft of mass moment of inertia  $J_s$  can be taken into effect by adding 1/3rd of its value to the mass moment of inertia of the disc J fitted at its end, in order to compute the natural frequency of the system. **05**
- Q.5 (a)** Four pulleys are equally spaced along a shaft and each has an out of balance mass at the same radius. The out of balance mass in the second pulley is 3 kg and the third and fourth out of balance masses are at  $72^\circ$  and  $220^\circ$  to it. Determine the masses in the first, third and the fourth pulleys and also the angle of the first mass relative to second. if the complete balance is to be obtained. **10**
- (b)** A 35 kg block is connected to a spring of stiffness  $1.7 \times 10^5$  N/m. The coefficient of friction between the block and the surface on which it slides is 0.11. The block is displaced 10 mm from equilibrium and released. (i) What is the amplitude of motion at the end of the first cycle? (ii) How many cycles of motion occur? **10**
- Q.6 (a)** A vehicle has a mass of 1200 kg, The suspension system has a spring constant of 400 kN/m and damping ratio 0.5. If the vehicle speed is 100 km/hr, determine the displacement amplitude of the vehicle. The road surface varies sinusoidally with an amplitude of 0.05 m and wavelength of 6m. **10**
- (b)** A spring mass damper system, having an undamped natural frequency of 100 Hz and a damping constant of 20 Ns/m, is used as an accelerometer to measure the vibration of a machine operating at a speed of 3000 rpm. If the actual acceleration is  $10 \text{ m/s}^2$  and the recorded acceleration is  $9 \text{ m/s}^2$ , find the mass and the spring constant of an accelerometer. **10**

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(3 Hours)

Total Marks : 80

- N.B.** (1) Question no. 1 is compulsory.  
(2) Attempt any **three** questions out of remaining **five** questions.  
(3) **Illustrate** your answer with **necessary** sketch wherever **necessary**.  
(4) **Figures** to the **right** indicate full **marks**.

1. Attempt **any FOUR** of the following : (20)
- (a) Classify common press working operations.
  - (b) Write Selection of steels and its hardness for different elements of Press tools.
  - (c) Write short note on defects in drawn parts.
  - (d) Sketch combination die and label all the parts.
  - (e) Write short note on safety in press shop.
2. (a) Explain methods of reducing cutting loads on press tools. (10)
- (b) Find the total pressure and dimensions of tools to produce a washer 4 cm outside diameter with 2 cm diameter hole from material 4 mm thick, having shear strength of 360 N/mm<sup>2</sup>. (10)
3. (a) Design a die for shell size 60 mm diameter and 25 mm height, corner radius is 3 mm, material is mild steel and sheet thickness is 2 mm. Yield stress is 200 N/mm<sup>2</sup> and shear stress is 120N/mm<sup>2</sup>. (10)
- (b) With the help of neat sketches explain metal flow in drawing & forming operations. (10)
4. (a) With the help of neat diagrams explain different types of bending dies. (10)
- (b) Explain overloading of Presses with respect to load and energy considerations. (10)
5. (a) Explain basic hydraulic and pneumatic circuit used in press for stock feeding. (10)
- (b) A press is designed to offer 90 ton of force at 20° crank angle with a stroke of 15 cm. Stroke is variable from 1cm to 15 cm. Calculate tonnage available when the ram is 3 cm above BDC. Take stroke length equal to 10 cm. (10)
6. Attempt **any FOUR** of the following : (20)
- (a) Write Benefits and limitations of using Press tools.
  - (b) With suitable example explain centre of pressure.
  - (c) Describe reduction ratio and redrawing limits
  - (d) With the help of neat sketch explain simple progressive die.
  - (e) Write short note on CNC press controller.

Duration: 3hrs

Max Marks: 80

- N.B.** (1) All questions carry equal marks.  
 (2) Question No. 1 is Compulsory.  
 (3) Attempt any three questions from remaining five questions.  
 (4) Figures to the right indicate full marks.  
 (5) Draw neat sketches wherever necessary.

- Que. 1 Attempt any **four** of the following: (20)  
 A. How the milling cutters are classified?  
 B. Name the different types of chips formed in metal cutting. Describe each type with the help of neat sketches.  
 C. Give different types of cutting fluids? Explain any two in details?  
 D. Explain milling dynamometer with neat sketch.  
 E. Explain Built Up Edge (BUE) formation and its influence on surface finish.  
 F. Explain orthogonal rake system (ORS) in detail.
- Que. 2 A. Discuss different cutting tool materials with their properties and application. (10)  
 B. The following observation were made during an orthogonal cutting operation: Depth of cut = 0.3 mm; Chip thickness = 0.6 mm; Rake angle =  $20^\circ$ ; Cutting velocity = 102 m/min; Cutting force = 300 N; Feed force = 120 N.  
 Determine: (i) Shear angle. (ii) Shear strain. (iii) Velocity of chip along the tool face. (iv) Work done in shear (10)
- Que. 3 A. Calculate the length of broach for roughing and finishing operation for machining a slot 10 mm in depth and 20 mm in width for 400 mm long steel piece having specific cutting energy of  $2000 \text{ N/mm}^2$ . Cutting speed is 5 m/min and chip space number 8. Taking roughing feed as 0.08 mm/tooth and finishing feed as 0.02 mm/tooth. Assume blunt broach factor (1.25 to 1.40) (10)  
 B. Define Tool Life and explain factors affecting tool life. (10)
- Que. 4 A. The tool life for a high speed steel (H. S. S.) tool is expressed by the relation  $V T^{0.143} = C_1$  and for Tungsten carbide (WC) is expressed as  $V T^{0.2} = C_2$ . If at a speed of 24 metre / min, the tool life is 128 minutes compare the life of the tools at a speed 30 metre / min. (10)  
 B. What are the sources of heat generation in metal cutting and also explain the distribution of temperature during metal cutting process. (10)
- Que. 5 A. Discuss the following design features of a reamer : (10)  
 Reaming allowance (ii) Diameter of reamer (iii) Length of body (iv) Back taper or relief (v) Rake and Clearance angle (vi) Number of teeth.  
 B i) Explain tool work thermocouple method with sketch for cutting temperature measurement. (10)  
 ii) Draw and explain design of simple step type chip Breaker.
- Que. 6 A. Explain the various elements of a single – point cutting tool with the help of a neat diagram. Also explain machine reference system (MRS). (10)  
 B. Clearly stating the assumption derive the relationship (10)  
 $2\theta + \beta - \alpha = \frac{\pi}{2}$  in Merchant's original theory.  
 Where;  $\theta$  = Shear angle,  $\alpha$  = Rake angle,  $\beta$  = Friction angle.

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