

(3 Hours)

[Total Marks: 80]

- N.B. : (1) Question No.1 is compulsory  
(2) Attempt any three out of remaining five questions  
(3) Figures to the right indicate full marks  
(4) Assume suitable data if necessary  
(5) Illustrate your answers with sketches wherever necessary

1. Solve any four: - **20**
- (a) Write short note on CVT
  - (b) State the advantages and disadvantages of Front engine front wheel drive
  - (c) State the different types of wheels and explain any one of them with a neat sketch
  - (d) Draw a neat sketch of Multiplate clutch
  - (e) Explain with a neat sketch the construction and working of steering linkage mechanism for independent suspension system
  - (f) Explain with a neat sketch the construction of Air brake system
- 2 (a) The bore of cylinder of the four-stroke diesel engine is 120 mm. The maximum gas Pressure inside the cylinder is limited to 4 Mpa. The cylinder head is made of cast iron and allowable tensile stress is  $40 \text{ N/mm}^2$ . Determine the thickness of cylinder head. The studs which are made of steel, have allowable stress as  $50 \text{ N/mm}^2$ . Calculate (i) Number of studs, (ii) nominal diameter of studs and (iii) pitch of studs. Draw the neat diagram for each component. **10**
- (b) Compare Torque tube drive and Hotchkiss drive with neat sketches. **10**
- 3 (a) Explain with a neat sketch the Davis steering mechanism? Also Explain with a neat sketch the hydraulic power assisted steering ? **10**
- (b) A single plate clutch is required to transmit 27 KW at 1600 rpm. The outer diameter of the plate is limited to 30 cm and intensity of pressure between the plates is not to exceed  $7 \text{ N/cm}^2$  assuming Uniform wear and coefficient of friction 0.3. Find the required inner diameter of the plate and axial force necessary to engage the clutch. **10**

- 4 (a) Explain with a neat sketch the construction & working of Master cylinder and wheel cylinder **10**
- (b) A vehicle having a wheelbase of 3.2m has its center of mass at 1.4m from the rear Wheels and 55mm from the ground level. It moves on level ground at a speed of 54 Km/Hr Determine the distance moved by the car before coming to rest on applying on the brakes to the
- i) rear wheels
  - ii) Front wheels
  - iii) all the four wheels
- The coefficient of friction between the tyres and the road is 0.5 **10**
- 5 (a) Explain Pneumatic and Hydro elastic suspension system. **10**
- (b) Explain semi floating and full floating type of rear axles with neat labelled diagram and load acting on rear axle **10**
- 6 (a) A four speed gear box is to have the following gear main shaft is ratios,1.0,1.5,2.48 and 3.93.The centre distance between the layshaft and the main shaft is 73.12 mm and the smallest pinion is to have at least 12 teeth with a diametral pitch of 3.25 mm.Find the number of teeth of the various wheels. Find the exact gear ratio. **10**
- (b) Explain with a neat sketch the construction & working of Synchromesh gear box. **10**

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- NB 1) Question No. 1 is compulsory  
 2) Attempt any three questions out of the remaining five questions.  
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 4) Assume suitable data wherever required but justify the same.

- Q1. Attempt any four** (20)
- A. State the difference in flexible automation and fixed automation with application.  
 B. Explain Automation migration strategy.  
 C. Define degree of Freedom (DOF) for robot. Explain robot anatomy with sketch.  
 D. Write short note on PLC Architecture.  
 E. Explain Linear regression and its application in AI.
- Q2** A. Design electro Pneumatic circuit for two cylinder operation with following sequence using 5/2 both side solenoid operated valve as DCV. (10)  
 A+ Delay B+ A-B-
- B. Explain concept of Artificial Neural Networks (ANN) in detail. List and define Terminologies of ANNs. (10)
- Q3** A. List Agents used in Artificial Intelligence. Explain any two in detail. (10)  
 B. Explain Breadth first search Algorithm in detail with example (05)  
 C. Write short note on Logistic regression. (05)
- Q4** A. Compare Supervised, Unsupervised and reinforcement learning with different parameters. (10)  
 B. Design simple hydraulic circuit for two cylinder operation with following sequence using 4/2 pilot operated valve as DCV using cascade method A+ B+ A- Delay B- With user option of single cycle – multi cycle. Also draw displacement diagram. (10)
- Q5** A. Explain depth first search algorithm with example. (08)  
 B. Write note on different actuation methods for Direction control valves (08)  
 C. Explain tree and graph search. (04)
- Q6** A. State and explain K-Means Clustering algorithm in detail. (08)  
 B. Write detail note on Meter in and Meter out circuits used in Hydraulics operations. (08)  
 C. Explain role and applications of timers and counters in PLC. (04)

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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) Explain the automatic stock feeding mechanism in a press.
  - (b) Describe the different stages of load stroke curve during the various stages of sheet metal cutting operation.
  - (c) Enlist the factors considered while selecting press for a particular application.
  - (d) Sketch an inverted die and label all the parts.
  - (e) How does 'direction of burr' affect the strip layout?
  
2. (a) Enlist the different devices used in a press for the safety of operator. Also explain the how each device provides safety to the operator. (10)
- (b) Give reasons for the following: (10)
  - i) Punch and die are always hardened.
  - ii) Punch control the hole size.
  - iii) Only two dowel pins are used in press tool assembly.
  - iv) Coil stock is not used for double pass strip.
  - v) For piercing operation shear is not provided on die.
  
3. (a) A cup without flange and of height 45 cm and outer diameter 65 cm is to be made from sheet metal 0.6 mm thick. Find the suitable number of draws. If the shear stress for sheet material is  $427 \text{ N/mm}^2$ , calculate the drawing pressure, blank holding pressure, press capacity. Also find the size of the blank required to draw the cup of given dimensions. The bottom corner of cup is round having radius as  $1.4 R$ . (10)
- (b) Explain with suitable sketches, the different stages in a shearing of a sheet metal. (10)
  
4. (a) A work piece in the form of rectangular stamping of size 50 mm x 50 mm is to be produced in 50,000 pieces. A circular hole of diameter 20 mm is to be cut at the centre of the blank. If a 2 mm thick material is used for the work piece with shear strength of  $425 \text{ N/mm}^2$ , calculate the following: i) cutting force ii) cutting clearance iii) Die and punch size iv) Shut height of press v) strip layout (10)
- (b) Explain the possible causes of the following defects in bending and also state the precautions to be taken to prevent or minimise these defects: (10)
  - i) Cracking
  - ii) Warping
  - iii) Marring.
 Also list the defects in drawn parts.

5. (a) Define centre of pressure. Explain the steps to find the centre of pressure. Take a suitable component and find its centre of pressure. (10)
- (b) Describe with sketch the construction and working of a compound die considering a suitable example. (10)
6. Attempt any FOUR of the following : (20)
- (a) State the important specifications of a press tool with its meaning.
- (b) Compare between compound and combination die.
- (c) Sketch a two-stage progressive die and punch arrangement for producing a washer and label all the parts.
- (d) Compare between fixed and spring-loaded stripper.
- (e) Define spring-back effect in relation to bending operation. Explain the reasons that develops spring-back in a sheet metal.

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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) What are the steps followed in vibration analysis? Briefly explain.
- (b) 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
- (c) Write short note on Holzer's method.
- (d) A spring-mass system has a natural period of 0.28 second .What will be the new period of the Spring constant is: (1) increased by 55% (2) decreased by 35%?
- (e) A rotating unbalance system consists of a disc of mass 2 kg, which is eccentric to the axis of shaft by 2mm. 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) Compare viscous and coulomb damping. Mention at least 5 points of difference

**Q.2 (a) Determine the equation of motion for the following system as shown in the Fig 1 and find the natural frequency of the system. 10**

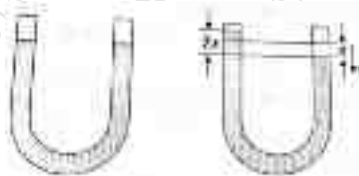


Fig. 1

(b) Use the free body diagram method to derive the differential equation governing the motion of the system of Fig 2. Use  $\theta$  as the generalized coordinate, assuming small  $\theta$ . 10

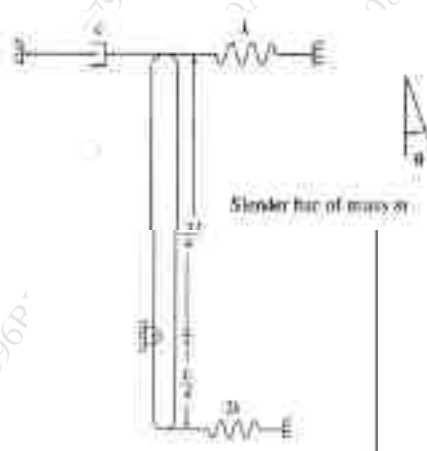


Fig. 2

- Q.3** (a) 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**
- (b) A 35 kg block is connected to a spring of stiffness  $1.7 \times 10^5 \text{ N/m}$ . 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.4** (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 vehicle. The road surface varies sinusoidally with amplitude of 0.05 m and wavelength of 6m. **10**
- (b) Use Lagrange's equation to derive the differential equations governing the motion of the system of fig. 2 using  $x_1$ ,  $x_2$  and  $x_3$  as the generalized coordinates. Also write the equations in matrix form. **10**

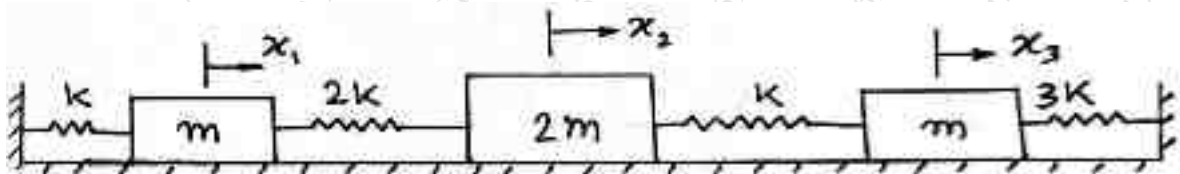


Fig. 2

- Q.5** (a) 30 N at 20cm, 20 N at 40cm, 10 N at 60cm from fixed end are the loading on a cantilever. The deflection under 10 N due to all loads is 02mm. 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**
- $$U_{ij} = \frac{S_i^2}{\text{constant}} (3S_j - S_i) \quad \text{for } S_i \geq S_j$$
- $$U_{ij} = U_{ji}, \quad 'S' \text{ is the distance from fixed end}$$
- (b) Define whirling speed. Derive the equation for the critical speed of a light shaft with a single disc without damping. **05**

- Q.6** (a) A shaft carries four masses A,B,C and D of magnitude 200 Kg, 300 Kg, 400 Kg and 200 Kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B  $45^\circ$ , B to C  $70^\circ$  and C to D  $120^\circ$ . The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions. **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**

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[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.  
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(5) Draw neat sketches wherever necessary.

- Que. 1 Attempt any four of the following: (20)
- A. Explain the difference between orthogonal and oblique cutting.
  - B. Explain crater wear and flank wear.
  - C. Sketch and discuss a typical internal broach.
  - D. Explain Strain gauge type dynamometer.
  - E. Explain MRS and ORS.
  - F. Write short note on: Polycrystalline diamond (PCD).
- Que. 2. A. Explain the procedure to draw Merchant force circle with some advantages and limitations. (10)
- B. Compare adhesive and abrasive wear with neat sketches. (10)
- Que. 3 A. Compare CVD and PVD. (10)
- B. State and briefly explain various methods to measure cutting temperature. (10)
- Que. 4 A. Explain design considerations for design of Tap. (10)
- B. Explain the various components of cost of machining a work piece which are included in product cost. (10)
- Que.5 A. Discuss the influence of various tool angles in tool signature on tool design. (10)
- B. Explain the constructional features of tipped tool and flat form tool. (10)
- Que.6 A. Determine the shear plane angle, cutting force component and resultant force on the tool for orthogonal cutting operation of material with yield stress of 250 N/mm<sup>2</sup>. Following are the machining parameters. (10)
- Tool rake angle = 20<sup>0</sup>, Uncut chip thickness = 0.30 mm, Chip width = 3mm Chip thickness ratio = 0.50 & Angle of friction = 42<sup>0</sup>
- B. Enlist the surface finish measurement technique and explain any one in detail. (10)
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