(3 hours)   **Total Marks:** 80

NB   1) **Question No. 1 is compulsory**
     2) **Attempt any three questions out of the remaining five questions.**
     3) **Figures to the right indicate full marks.**
     4) **Assume suitable data wherever required but justify the same.**

Q1.   **Attempt any four**   (20)

A. Explain the difference between programmable and flexible automation.
B. Explain Automation migration strategy.
C. List and explain types of joints used in Robots.
D. Identify the component and explain the functioning of the component.
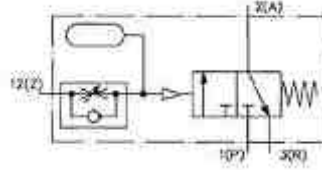
E. What is an end effector? Explain the magnetic gripper with suitable example.

Q2 **A.** Design electro Pneumatic circuit for two cylinder operation with following   (10)
sequence using 5/2 both side solenoid operated valve as DCV.
                    A+B+Delay B- A-
With user selection option single cycle Multicycle operation.
B. Explain concept of Artificial Neural Networks (ANN) in detail. List and define   (10)
Terminologies of ANNs.

Q3 **A.** What is a significance of Cascade method? List rules for cascade method along   (10)
with example.
B. Differentiate between PLC and Relays.   (05)
C. Write short note on industrial application of Robots.   (05)

Q4 **A.** Compare Supervised, Unsupervised and reinforcement learning with different   (10)
parameters.
B. Design simple pneumatic circuit for two cylinder operation with following   (10)
sequence using 4/2 pilot operated valve as DCV using cascade method
                    Delay B+ A+ A- B
With user option of single cycle – multi cycle. Also draw displacement diagram.

Q5 **A.** Explain depth first search algorithm with example.   (08)

B. Write note on different actuation methods for Direction control valves   (05)
C. Explain linear regression technique with suitable example.   (05)

Q6 **A.** Explain hierarchical Clustering with as example.   (08)
B. Write detail note on Meter in circuit used in Hydraulics operations.   (05)
C. For a given data set [2,4,10,12,3,20,30,11,25], find the final cluster centres using   (05)
K=2 clusters.
                    =====================XOX=====================

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3 Hours (80 Marks)

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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 semi-centrifugal clutch with neat sketch.

   b) Explain front engine rear wheel drive's salient features, advantage and disadvantages.

   c) Explain the role of constant velocity joint in automobile.

   d) 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 rod is 0.6. If the permissible stress in the material of the shaft is not allowed to exceed 22072.5×10^4 Pa, find the diameter of the axle shaft.

   e) Explain the working of torsion bar with neat sketch.

   f) Explain the pneumatic or air brakes with neat sketch.

2. a) Briefly describe construction and working of disc brakes. Compare them with the conventional drum brakes. (10)

   b) 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)
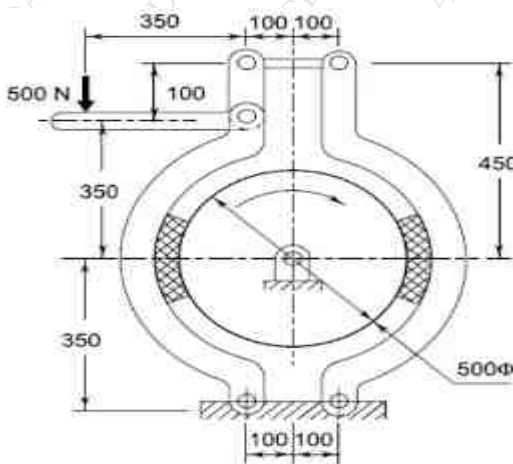
3. (a) An automotive gear box gives three forward speeds and one reverse with a top gear of unity and bottom and reverse gear ratio of approximately 3.3:1. The centre distance between the shafts is to be 110 mm approximately. Gear teeth of module 3.25 mm are to be employed. Sketch the layout of a typical 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 construction of sliding mesh gearbox with suitable figure. **(10)**

4. (a) Design a connecting rod for a high speed diesel engine using the following data **(12)**

     Cylinder bore = 125 mm

     Stroke = 140 mm

     Length of connecting rod = 350 mm

     Speed = 2000 RPM

     Mass of reciprocating parts = 1.5 kg

     Maximum gas pressure = 3 MPa

     Factor of safety against buckling = 5

  (b) Explain Construction and Working of differential with neat sketch. **(08)**

5) (a) Explain the working of rear independent suspension system with neat sketch and compare with dependent suspension system. **(10)**

  (b) A four stroke diesel engine has the following specifications:
Brake Power = 5kW; Speed = 1200rpm; Indicated mean effective pressure = 0.35 N/mm^2;
Mechanical Efficiency = 80%.
Determine: 1.bore and length of the cylinder; 2. Thickness of the cylinder head; and 3. Size of studs for the cylinder head. **(10)**

6. Write short note on **(Any Four)** **(20)**

    a) Torque converter

    b) Transfer case.

    c) Types of road wheels.

    d) Types of adaptive suspension system.

    e) Drive line arrangements.

    f) Hotchkiss drive

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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 short notes on vibrometer. Also sketch related frequency response curve.

(b) A thin circular disk of mass 2.5 Kg and radius 200 mm is suspended at a point on the circumference. Calculate mass-moment-of-inertia about the pivot axis.

(c) Describe static and dynamic balancing of multi rotor system in details

(d) Explain seismometer with neat system's diagram. Write formula related to the said system. Also sketch frequency response curve for the same.

(e) A system has a mass 5 kg, and a spring of stiffness 1 KN/m. Calculate undamped time period.

(f) Explain Critical speed of single rotor damped system.

Q.2   **(a)** What is the equivalent stiffness of the system of Fig: 1 using the displacement of the block as the generalized coordinate   **10**

$$E = 210 \times 10^9 \ \frac{N}{m^2}$$

$$I = 1.5 \times 10^{-5} \ m^4$$

2.5 m

$5 \times 10^5 \ \frac{N}{m}$

$2 \times 10^5 \ \frac{N}{m}$
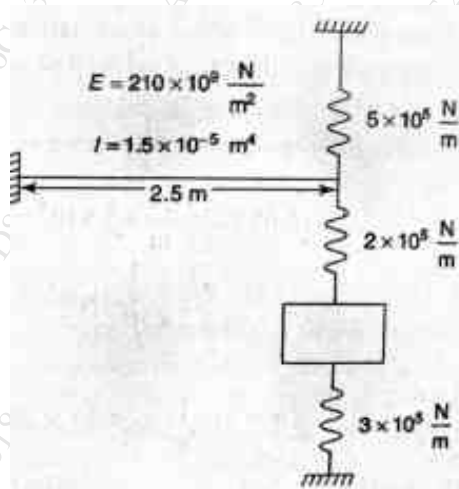
$3 \times 10^5 \ \frac{N}{m}$

Fig.1

(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**
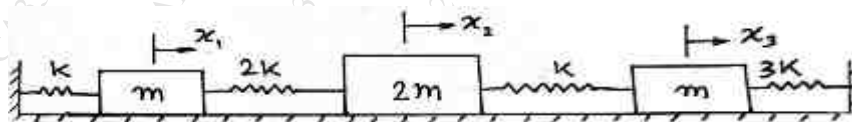

Fig. 2

Q.3   **(a)** A spring mass damper system, having an undamped natural frequency of 100 Hz and a damping constant of 25 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 m/s^2 and the recorded acceleration is 9 m/s^2, find the mass and the spring constant of an accelerometer.   **10**

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(b) A machine of mass 500 Kg is acted upon by an external force of 2000 N at a frequency of **10**
1500 r/min. To reduce the effect of vibration, an isolator of rubber having a static deflection
of 2 mm under machine load and an estimated damping factor $\xi = 0.2$ are used. Determine :
    (i)   The force transmitted to the foundation.
    (ii)   The amplitude of vibration of the machine.

Q.4 **(a)** Find one of the natural frequencies of the vibrations of the system shown in fig. 3 for the **10**
frequency range 15-20 r/s. Take $K_1 = K_7 = 0$, $K_2 = K_3 = K_4 = K_5 = K_6 = 100$ N/m and values of
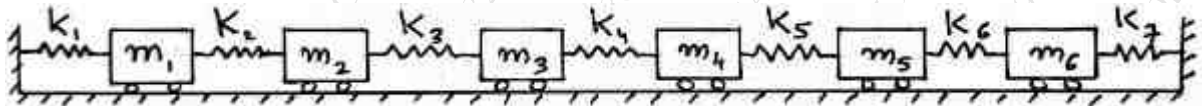all masses = 1Kg.

Fig.3

(b) Explain the balancing of static and dynamic balancing of multi rotor system. **05**

(c) How do you find the response of a viscously damped system under rotating unbalanced? **05**

Q.5 **(a)** 30 N at 20cm, 20 N at 40cm, 10 N at 60cm from fixed end are the loading on a cantilever. **15**
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,

$$U_{ij} = \frac{s_i^2}{constant}(3S_j - S_i) \quad \text{for } S_i \not\geq S_j$$

$U_{ij} = U_{ji}$, 'S' is the distance from fixed end

(b) Define whirling speed. Derive the equation for the critical speed of a light shaft with a single **05**
disc without damping.

Q.6 **(a)** 1000 kg machine is mounted on four identical spring of total spring constant "K" and having **10**
negligible damping. The machine is subjected to a harmonic external force of amplitude Fo =
500N and frequency 180 rpm. Determine the amplitude of motion of the machine and
maximum force transmitted to foundation because of unbalanced force when K= 1.96 x 10^6
N/m.

(b) A four cylinder engine has cranks arranged symmetrically along the shaft as shown figure 4. **10**
The distance between the outer cranks A and D is 5.4 m and that between the inner cranks B
and C is 2.4 m the mass of the reciprocating parts belonging to each of the outer cylinder is 2
tones and the belonging to each of the inner cylinder is m tones.

If the primary and secondary forces are to be balanced and also the primary couples,
determine the crank angle positions and the mass of the reciprocating parts (m)
corresponding to the inner cylinders.

Find also the maximum value of the unbalanced secondary couple, if the stroke is 1 meter,
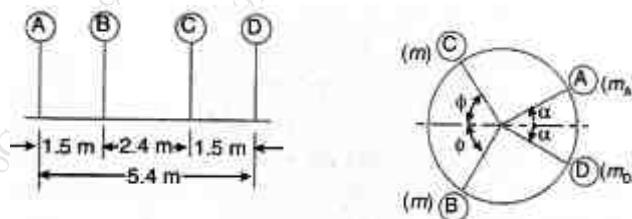the connecting rod length 2 meters and speed of the engineers 110 rpm.

Fig.4

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Duration: 3hrs [Max Marks:80]

N.B. : (1) Question No 1 is Compulsory.
      (2) Attempt any three questions out of the remaining five.
      (3) All questions carry equal marks.
      (4) Assume suitable data, if required and state it clearly.

1   Attempt any FOUR [20]

  a Explain Categorical data and quantitative data.

  b Find S.D of the average temperature recorded over a five-day period last winter
     18,22,19,25,12

  c Define Binomial distribution and Poisson distribution.

  d Explain Type1 and Type 2 error in detail.

  e Define the following key terms for simple linear regression.
     i)Response ii) Record iii) Independent variable iv) Regression co-efficient v)
     Residuals

2 a The runs scored in a cricket match by 11 players are as [10]
     follows:7,16,121,51,101,81,1,16,9,11,16.
     Find mean, mode, median for the given data.

  b An agent sells life insurance policies to five equally aged healthy people. [10]
     According to recent data, the probability of a person living in these conditions
     for 30 years or more is 2/3.Caluclate the probability that after 30 years if

       i)   All five people are still living.

       ii)   At least three people are still living.

       iii)   Exactly two people are still living (Hint: Binomial Distribution)

3 a X is a normally distributed variable with mean μ=30 S. D σ=4.Find i) P(X<40) [10]
     ii)P(X>21) iii) P(30<X<35)

  b Brief the steps in multinomial distribution goodness of fit. Elaborate the steps [10]
     with an example.

4 a Brief the steps in test of independence. Elaborate the steps with an example [10]

  b Find the simple linear regression that fits the given data and co efficient of [10]
     determination.

Bill	34	108	64	88	99	54
Tip	5	17	11	8	14	5

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5 a In the context of multiple linear regression. Explain what is over fitting and multi [10]
collinearity.

b Predict equation for y. [10]

y	x1	x2
-3.7	3	8
3.5	4	5
2.5	5	7
11.5	6	3
5.7	2	1

6 a Explain TIME SERIES PATTERNS [10]

i)Horizontal Pattern ii) Trend Pattern iii)Seasonal Pattern

iv)Trend and Seasonal Pattern v)Cyclical Pattern

b Consider the following time series data. [10]

Week	1	2	3	4	5	6
Value	18	13	16	11	17	14

Using the naive method (most recent value) as the forecast for the next week,

compute the following measures of forecast accuracy.

i) Mean absolute error. ii) Mean squared error.

iii) Mean absolute percentage error. iv) Determine the forecast for week 7?

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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		Write Short Note on: <u>**Any four**</u> out of six.	(20)
	A.	Types of chips.	
	B.	Applications of Cutting fluids.	
	C.	Primary and secondary cutting edge finish.	
	D.	Tool wear mechanisms.	
	E.	Cutting tip and Chip breakers in carbide tools	
	F.	Multi-point Form tools.	

Que. 2   A.   An orthogonal cut 2.5 mm wide is made at a speed of 0.5 m/sec and feed of 0.26   (10)
mm with a H.S.S. tool having a 20^0 rake angle. The chip thickness ratio is found
to be 0.58, the cutting force is 1400N and the feed thrust force is 360 N. Find: (i)
Chip thickness (ii) Shear plane angle (iii) Resultant force (iv) Coefficient of
friction on the face of the tool (v) Friction force and normal force on the shear
plane (vi) Specific energy.

         B.   What are the sources of heat generation in metal cutting and also explain the   (10)
distribution of temperature during metal cutting process.

Que. 3   A.   Prove that the relationship $2\emptyset + \beta - \alpha = \frac{\pi}{2}$ holds good in orthogonal   (10)
cutting, where Ø = Shear angle, α = Rake angle, β = Friction angle. Also state
your assumptions.

         B.   (i) Explain milling dynamometer with neat sketch.   (10)
             (ii) Write the ISO coding system for tipped tool (Insert)

Que. 4   A.   Derive an expression for optimum cutting speed and tool life for maximum   (10)
production rate. Also write the assumptions associated to it

         B.   (i) Discuss tool angles in ASA system with neat sketch   (10)
             (ii) Write the properties of cutting tool material and explain cubic boron nitride
(CBN).

Que. 5   A.   Discuss the following design features of a reamers: (10)

           (i) Reaming allowance (ii) Diameter of Reamer (iii) Length of body (iv) Number of teeth (v) Rake angle and clearance angle.

       B.   Explain the various steps involved in the design of circular broach and draw the neat diagram.   (10)

Que. 6   A. $VT^{0.20} = 640$ is the Taylor tool life equation for Carbide tool-steel workpiece obtained experimentally, where V is in m/min and T is in min. A batch of 1000 steel parts, each 100 mm in diameter and 250mm in length is to be rough turned using a feed of 0.2 mm/rev. If the cost per cutting edge of the throw-away carbide insert is Rs.60, time required to reset the cutting edge is 1 min and the total machine rate (including Operator cost) is Rs.300/hr.   (10)

           Calculate: (i) Optimum cutting speed for min. cost of production. (ii) Corresponding tool life. (iii) Total production cost if time taken to load & unload the component is 2 min and initial setup time is 2 Hrs. (iv) Total production time for the given batch.

       B.   (i) How is the tool shank of a single point cutting tool designed ?   (10)

           (ii) Explain synthetic and polycrystalline diamond (PCD).

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(**3 Hours**) (**Maximum Marks: 80**)

NB. 1. **Question** number **One** is compulsory
2. Attempt **any three out of remaining five** questions
3. Assume suitable data
4. Figures to the right indicate the maximum marks

Q1 **Attempt any FOUR:** (**20**)

a) Define and classify Cybercrime

b) Comment on Windows OS Artifacts

c) Explain Principles of Digital Forensic.

d) Which are the Goals of Incident Response

e) How to Acquire Image over a Network

Q2 a) Explain Digital Forensics and its lifecycle. (**10**)

b) Explain in detail Incidence Response Methodology (**10**)

Q3 a) Describe Steps to prevent cybercrime and explain Hackers, Crackers and Phreakers (**10**)

b) Explain Forensic Investigation Report Writing in terms of Standards, Content, Style, Formatting and Organization. (**10**)

Q4 a) Describe Digital Investigation Staircase Model (**10**)

b) How to Acquire an Image with dd Tools and with Forensic Formats (**10**)

Q5 a) Describe in details OS File Systems. (**10**)

b) Explain Network-Based Evidence acquisition and its analyzing. (**10**)

Q6 a) Explain Need and types of Computer Forensic Tools in detail. (**10**)

b) In Mobile Forensics explain Challenges, Evidence Extraction Process, Types of Investigation, and Procedure for Handling an Android Device. (**10**)

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