

**B. TECH. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
MECHANICAL VIBRATION (MEC4110/ME411)**

Maximum Marks: 60

Credits: 04

Duration: Two Hours

*Answer all the questions.**Assume suitable data if missing.**Notations used have their usual meaning.*

Q.No.	Question	M.M.	CO
1 (a)	If $x(t)$ is a periodic function with period " τ ", its Fourier series representation is given by	[01]	CO1
(b)	What is the effect of inertia of the constraint (cantilever of mass " m " carrying a heavy end mass " M ") on the natural frequency in the transverse vibration?	[01]	CO1
(c)	In a single degree of freedom viscously damped (underdamped) system, write down the expression for logarithmic decrement in terms of damping factor.	[01]	CO1
(d)	The natural frequency of a spring-mass system is found to be 2 Hz. When an additional mass of 1 kg is added to the original mass m , the natural frequency is reduced to 1 Hz. Find the spring constant k and the mass m .	[02]	CO1
(e)	A 35-kg block is connected to a spring of stiffness 1.7×10^5 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. What is the amplitude of motion at the end of the first cycle?	[02]	CO1
1 (f)	A 4 kg mass is attached to a spring of stiffness 400 N/m and a viscous damper of coefficient 16 N-sec/m as shown in Fig. 1. If the mass is displaced 0.5 m from its equilibrium position and released from rest, determine the position of the mass after it has oscillated through 3 cycles from the point of release.	[08]	CO1

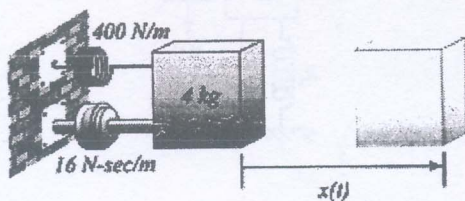


Fig. 1

OR

contd...2.

- 1 (f) A body of mass $M = 1 \text{ kg}$, lies on a dry horizontal plane and is connected by spring to a rigid support. The body is displaced from the unstressed position by an amount equal to 0.255 m with the tension in the spring at this displacement equal to 49 N and then released with zero velocity. How long will the body vibrate and at what distance from the unstressed position will it stop if the coefficient of friction is 0.25 ? [08] CO1
- 2 (a) How is the magnification factor related to the frequency ratio of damped spring mass system? [01] CO2
- (b) Will the force transmitted to the base of a spring-mounted machine decrease with the addition of damping? [01] CO2
- (c) The response of dynamic system to suddenly applied nonperiodic excitation is called _____? [01] CO2
- (d) Define Beating phenomenon. [01] CO2
- (e) The value of the amplitude ratio at resonance is called _____? [01] CO2
- 2 (f) Find the steady state response of the system shown in Fig. 2 for the following data: $k_1=1000\text{N/m}$, $k_2=500\text{N/m}$, $m=10\text{kg}$, $r=5 \text{ cm}$, $J_0=1 \text{ kg-m}^2$, $F_0=50 \text{ N}$, $\omega=20\text{rad/s}$. Derive the equations used. [10] CO2

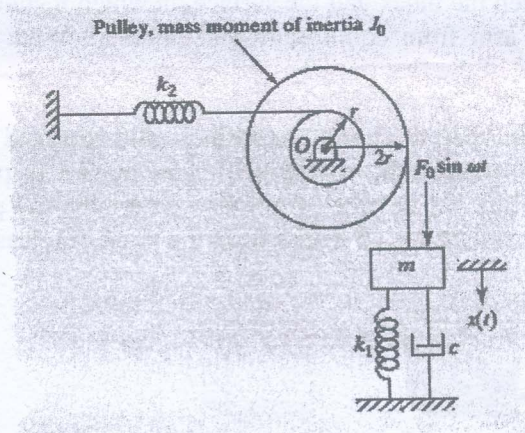


Fig. 2

- 3 (a) Explain the term semi definite system. [01] CO3
- (b) What is the basic assumption made in deriving Dunkerley s formula? [01] CO3
- (c) What is Rayleigh's quotient? [01] CO3
- (d) Define these terms: mass coupling, velocity coupling, elastic coupling. [02] CO3

Contd... 3.

(e) Write down the equation of motion for the system shown in Fig. 3.

[02] CO3

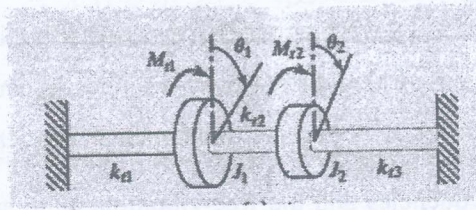


Fig. 3

3 (f) Determine the natural frequencies and find the free vibration solution of the unrestrained system shown in Fig. 4 for the following data: $m_1=1$ kg, $m_2=2$ kg, $k=200$ N/m, $x_1(0) = 0.1$ m, $x_2(0) = 0$, $\dot{x}_1(0) = 0$ and $\dot{x}_2(0) = 0$.

[08] CO3

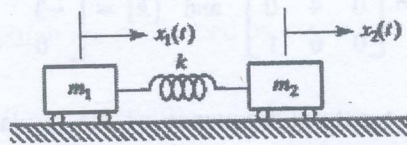


Fig. 4

OR

3 (f) Find the natural eigenvalues and eigenvectors of the system shown in Fig. 5 for $k_1=k$, $k_2=2k$, $k_3=3k$, $m_1=m$, $m_2=2m$ and $m_3=3m$. Also plot the mode shapes.

[08] CO3

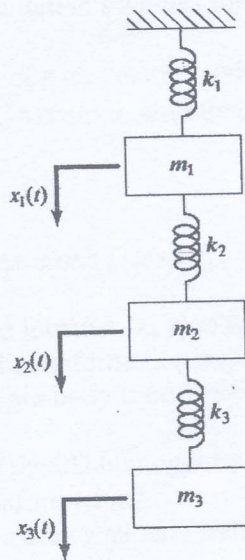


Fig. 5

4 (a) The dynamical matrix, $[D]$, is given by _____.

[01] CO4

contd... 4.

- (b) The boundary condition corresponding to the free end of a bar in longitudinal vibration is given by _____ [01] CO4
- (c) Write down the equation governing the free torsional vibration of a uniform shaft. [01] CO4
- (d) How does a continuous system differ from a discrete system? [02] CO4
- (e) A stretched cable of length 2 m has a fundamental frequency of 3000 Hz. Find the frequency of the third mode. [02] CO4
- 4 (f) Find the natural frequencies and the free-vibration solution of a bar undergoing longitudinal vibration whose one end is fixed and the other end is free. [08] CO4

OR

- 4 (f) The mass and stiffness matrices of an airplane in flight, with a three-degree-of-freedom model for vertical motion are given by: [08] CO4

$$[m] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 1 \end{bmatrix} \text{ and } [k] = \begin{bmatrix} 3 & -3 & 0 \\ -3 & 6 & -3 \\ 0 & -3 & 3 \end{bmatrix}$$

Determine the highest natural frequency of the airplane using Matrix iteration method.

2023-2024
B.TECH. (ODD SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
Computer Aided Design (MEE4150)

Duration: TwoHours

Credits:04

Max. Marks: 60

All questions are compulsory and marks are indicated against each question.

Notations used have their usual meaning

Q. No.	Question	M.M.
Q1 (a).	<i>Attempt any three questions. Each Question carries 1 mark.</i>	(3x1=3 marks)
(i)	List the design tasks which are performed by computer-aided design system.	(CO1)
(ii)	The geometric primitives in CSG are.....	(CO1)
(iii)	CAD model forms an input for.....and can be used for generating the NC code.	(CO1)
(iv)	What are the applications of mechanical CAD model?	(CO1)
Q1 (b).	<i>Attempt any two questions. Each Question carries 2 marks.</i>	(2x2=4 marks)
(i)	What are the fundamental reasons for implementing a CAD system?	(CO1)
(ii)	What are Boolean functions and how are they used?	(CO1)
(iii)	Discuss the various representation schemes for solid model.	(CO1)
Q1(c).	What are the requirements of a geometric model? Mention the different modelling modes used in CAD along with their advantages and disadvantages.	8 marks (CO1)
Q2 (a).	<i>Attempt any three questions. Each Question carries 1 mark.</i>	(3x1=3 marks)
(i)	An object which is at fixed location (x, y) is to be uniformly scaled with a factor s. The concatenated transformation matrix is.....	(CO2)
(ii) is the rigid body transformation that moves the body without deformation.	(CO2)
(iii)	Which elements/ terms of the 2D homogeneous transformation matrix represent perspective transformation?	(CO2)
(iv)	A unit square is transformed by a general transformation matrix. Find out the area of the transformed square.	(CO2)

Contd.....20

Q2 (b). *Attempt all the questions. Each Question carries 2 marks.* (2x2=4 marks)

- (i) Given the triangle, described by (2,2), (2,5), and (5,5) the, scale it by a factor 3/4, keeping the centroid in the same location. Use condensed matrix for transformation. (CO2)
- (ii) Write the elements of transformation matrix T for (1) shear along x and y axes (2) reflection about $x = y$. (CO2)

Q2(c). A general 2x2 transformation given by matrix $T = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is applied on a pair of perpendicular lines. Derive the conditions under which perpendicular lines transform as perpendicular lines. Name the transformation operation. **8 marks** (CO2)

OR

Q2(c'). Write down the sequence of transformations for reflection about an arbitrary line. Consider two lines passing through the origin with slopes m_1 and m_2 respectively and show if two pure reflection transformations about these lines are applied successively, the result is a pure rotation. Find the angle of rotation. **8 marks** (CO2)

Q3 (a). *Attempt all the questions. Each Question carries 1 mark.* (3x1=3 marks)

- (i) Rasterisation is..... (CO3)
- (ii) Parametric form of a circular helix is..... (CO3)
- (iii) Bilinear surface is obtained by..... (CO3)

Q3 (b). *Attempt all the questions. Each Question carries 2 marks.* (2x2=4 marks)

- (i) Explain the Bresenham Line Drawing Algorithm. (CO3)
- (ii) What is a convex hull property of Bezier curve and how it is useful? (CO3)

Q3(c). What is a parametric cubic patch? Give its mathematical form and the detailed expression of geometric coefficient matrix. **8 marks** (CO3)

OR

Q3(c'). Derive the matrix form of parametric Bezier curve? Also list the properties and limitations of Bezier curve. **8 marks** (CO3)

Contd...-3.

Q4 (a). Attempt all the questions. Each Question carries 1 mark. (3x1=3 marks)

- (i) List four applications of engineering optimization. (CO4)
- (ii) Is optimization a CAD problem? If yes, justify. (CO4)
- (iii) Draw the Constraint surface and mention the different constraints and domains. (CO4)

Q4 (b). Attempt all the questions. Each Question carries 2 marks. (2x2=4 marks)

- (i) Differentiate between static and dynamic optimization problem with the help of an example. (CO4)
- (ii) Write the optimization problem statement of Geometric Programming Problem. (CO4)

Q4(c). A scaffolding system consists of three beams and six ropes as shown in Fig. 1. Each of the top ropes A and B can carry a load of W_1 , each of the middle ropes C and D can carry a load of W_2 , and each of the bottom ropes E and F can carry a load of W_3 . **8 marks**
(CO4)

If the loads acting on beams 1, 2, and 3 are x_1 , x_2 , and x_3 , respectively, as shown in Fig. 1.12, formulate the problem of finding the maximum load ($x_1 + x_2 + x_3$) that can be supported by the system and comment on the nature of optimization problem. Assume that the weights of the beams 1, 2, and 3 are w_1 , w_2 , and w_3 , respectively, and the weights of the ropes are negligible.

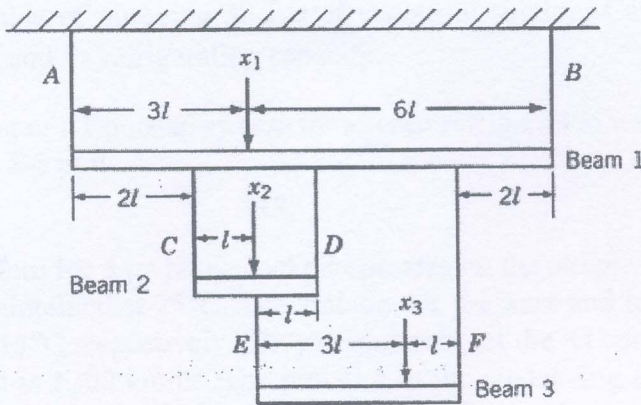


Fig 1: Scaffolding system with three beams

OR

Q4(c'). Figure 2 shows two bodies, A and B, connected by four linear springs. **8 marks**

Moderated

Contd... 40

The springs are at their natural positions when there is no force applied to the bodies. The displacements x_1 and x_2 of the bodies under any applied force can be found by minimizing the potential energy of the system. Find the displacements of the bodies when forces of 1000 lb and 2000 lb are applied to bodies A and B, respectively, using Newton's method. Use the starting vector, $\mathbf{X}_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$. (CO4)

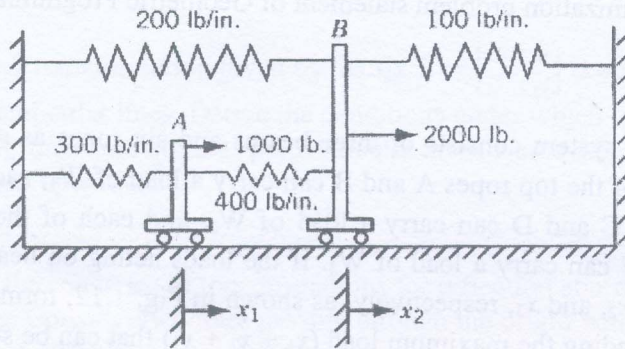


Fig 2: Two bodies connected by springs

2023-24

**B.Tech. (ODD SEMESTER) EXAMINATION
(BACKLOG MECHANICAL ENGINEERING)
REFRIGERATION & AIR CONDITIONING
(MEE4230)**

Max Marks: 60

Duration: 2 Hours

Note: 1. Answer all the questions.

2. Assume suitable data if missing. Notations used have their usual meaning.

3. Marks allotted to each question and course outcome (CO) covered are indicated against each question.

4. Use of Refrigeration table and chart is allowed.

Q.No.	Questions	COs	M.M.
1(a)	A Carnot refrigerator operates with Refrigerant 134a as a refrigerant condensing at 50°C and evaporating at -15°C. Find its COP and the power consumption per ton of refrigeration.	[CO1]	[04]
1(b)	Discuss the effect of subcooling on the performance of a vapour compression refrigeration system.	[CO1]	[04]
1(c)	Explain the Cascade refrigeration system with the help of a schematic and p-h plot.	[CO1]	[07]
OR			
1(c')	A Refrigerant 22 vapour compression system meant for food freezing operates at 40°C condensing temperature and -30°C evaporating temperature. Its compressor is capable of pumping 30 L/s of vapour at suction. Calculate the COP of the system and its refrigerating capacity..	[CO1]	[07]
2(a)	Explain the working of a Bootstrap system for aircraft refrigeration with the help of a schematic and T-s plot.	[CO2]	[07]
OR			
2(a')	An air-cooling system for a jet plane cockpit operates on the simple cycle. The cockpit is to be maintained at 25°C. The ambient air pressure and temperature are 0.35 bar and -15°C, respectively. The pressure ratio of the jet compressor is 3. The plane speed is 1200 km/hr. The pressure of the air leaving the cooling turbine is 1.06 bar and that in the cockpit is 1.01 bar. The cockpit cooling load is 60 kW. Calculate (a) Mass flow rate of the air circulated, (b) Net power delivered by the engine to the refrigeration unit and (c) COP of the system.	[CO2]	[07]
2(c)	With the help of schematic diagram, explain the working principle of ammonia-water vapour absorption refrigeration system.	[CO2]	[08]
3(a)	What is thermal comfort? What are the factors influencing the thermal comfort?	[CO3]	[04]

3(b) Define Wet Bulb Temperature (WBT) showing the process in wet bulb thermometer on a T-s plot. Also, discuss thermodynamic wet bulb temperature. [CO3] [05]

OR

3(b') For a dry bulb temperature of 25°C and a relative humidity of 55 per cent, when the barometric pressure is 740 mm Hg. Determine the (a) Partial pressures of water vapour and dry air and (b) Dew point temperature. [CO3] [05]

3(c) In an air conditioning system air at a flow rate of 2 kg/s enters the cooling coil at 20°C and 50% RH and leaves the cooling coil at 10°C and 90% RH. The apparatus dew point of the cooling coil is 5°C. Assume the barometric pressure to be 1 atm. Assume the condensate water to leave the coil at ADP ($h_w = 29.26$ kJ/kg). Determine (a) The cooling capacity of the coil, (b) Sensible Heat Factor for the process, and (c) By-pass factor of the cooling coil. [CO3] [06]

4 (a) Differentiate between comfort air-conditioning and industrial air-conditioning. [CO4] [03]

4 (b) Explain the concept of degree day. How it is used for winter air-conditioning? [CO4] [05]

OR

4 (b') Explain the different losses during the air flow through a duct. [CO4] [05]

4 (c) What are the different methods used for duct sizing? Explain any one of them. [CO4] [07]

2023-24

**B.Tech. (ODD SEMESTER) EXAMINATION
(MECHANICAL ENGINEERING/FOOD TECHNOLOGY)
REFRIGERATION & COLD CHAIN
(MEE4231/MEA3011)**

Max Marks: 60

CREDITS:04/03

Duration: 2 Hours

Note: 1. Answer all the questions.**2. Assume suitable data if missing. Notations used have their usual meaning.****3. Marks allotted to each question and course outcome (CO) covered are indicated against each question.****4. Use of Refrigeration table and chart is allowed.**

Q.No.	Questions	COs	M.M.
1(a)	Determine the power consumption of a domestic refrigerator if its refrigerating capacity is 0.13TR. It is operating in an ambient of 40°C. Temperature in the freezer must be maintained at -15°C. COP of the system is half the Carnot COP.	[CO1]	[04]
1(b)	Discuss the effect of superheating on the performance of a vapour compression refrigeration system.	[CO1]	[04]
1(c)	Discuss multi-stage vapour compression refrigeration systems with flash gas removal with the help of a schematic and p-h plot.	[CO1]	[07]
OR			
1(c')	A simple vapour compression refrigeration system using Freon 22 operates on simple saturation cycle with the Refrigerating capacity 15 TR, Condensing temperature 40°C and Evaporating temperature 6°C. Calculate: (a) Refrigerant circulation rate in kg/s, (b) Power required by the compressor in kW, (c) Coefficient of performance and (d) Volume flow rate of the refrigerant at compressor suction.	[CO1]	[07]
2(a)	Explain the working of a Regenerative system for aircraft refrigeration with the help of a schematic and T-s plot.	[CO2]	[07]
OR			
2(a')	An air-cooling system for a jet plane cockpit operates on the simple cycle. The cockpit is to be maintained at 25°C. The ambient air pressure and temperature are 0.35 bar and -15°C respectively. The pressure ratio of the jet compressor is 3. The plane speed is 1200 km/hr. The pressure of the air leaving the cooling turbine is 1.06 bar and that in the cockpit is 1.01 bar. The cockpit cooling load is 60 kW. Calculate (a) Mass flow rate of the air circulated, (b) Net power delivered by the engine to the refrigeration unit and (c) COP of the system.	[CO2]	[07]
2(c)	With the help of schematic diagram, explain the working principle of water-lithium bromide vapour absorption refrigeration system.	[CO2]	[08]

Contd... 20

3(a) Why a hermetic type compressor is used in domestic refrigeration systems? [CO3] [04]

3(b) Compare the merits and demerits of water cooled and air-cooled condensers used in refrigeration systems? [CO3] [05]

OR

3(b') Discuss the advantages, disadvantages and applications of a Thermostatic expansion valve used in refrigeration systems. [CO3] [05]

3(c) Explain the ODP and GWP of a refrigerant. Discuss the alternative refrigerants used in present refrigeration systems? [CO3] [06]

4 (a) Explain the importance of cold storages in food industry. [CO4] [04]

OR

4 (a') Discuss the cold chain and cold chain management. [CO4] [04]

4 (b) Explain the function of a Eutectic Plate and discuss its application. [CO4] [04]

OR

4 (b') Discuss chilling injury and its symptoms. [CO4] [04]

4 (c) What is dry ice? Explain its manufacture with the help of p-h diagram. [CO4] [07]



2023-24
B.TECH. (ODD SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
AUTOMOTIVE ENGINEERING
(MEE4240)

Maximum Marks: 60

Credits: 04

Duration: Two Hours

Attempt all questions.

Notations used have their usual meaning.

Q. No.	Questions	M.M.
1 (a)	Which type of lubrication system is used in 4-stroke automobile engines?	[01] CO1
1 (b)	Which anti-freeze additive is most commonly used in the coolant?	[01] CO1
1 (c)	The function of Antilock Brake System (ABS) is to (i) reduce the vehicle's stopping distance (ii) minimize brake fade (iii) maintain directional control without wheel locking (iv) prevent nose dives during braking	[01] CO1
1 (d)	Why is water cooling preferred over air cooling system?	[02] CO1
1 (e)	What is meant by power brakes?	[02] CO1
1 (f)	Explain the working of hydraulic braking system. How the failure of hydraulic braking system can be avoided?	[08] CO1
OR		
1 (f)	With the help of a neat sketch, explain the working of electronic-hydraulic ABS system.	[08] CO1
2 (a)	What are the two types of spark plugs?	[01] CO2
2 (b)	How can we achieve variable valve timings?	[01] CO2
2 (c)	What is the voltage across the electrodes of spark plugs?	[01] CO2
2 (d)	How do you control spark advance and spark retard?	[02] CO2
2 (e)	What are the recent advances in ignition system?	[02] CO2
2 (f)	Differentiate between battery and magneto ignition system.	[08] CO2
OR		
2 (f)	Write a detailed note on fuel injection system in petrol engines.	[08] CO2
3 (a)	List various components of transmission system of an automobile.	[01] CO3
3 (b)	What is the basic difference between fluid coupling and torque converter?	[01] CO3
3 (c)	In which type of vehicles, propeller shafts are used?	[01] CO3

contd...2.

- 3 (d) Briefly explain the function of final drive in a drive train of an automobile. [02] CO3
- 3 (e) What is the role of clutch plate, pressure plate and coil spring in a friction clutch? [02] CO3
- 3 (f) Describe the working of a Differential in an automobile with the help of suitable diagram. [08] CO3

OR

- 3 (f) With the help of a neat sketch, explain the working of 4-speed sliding mesh gear box. [08] CO3
- 4 (a) What do you mean by wheel alignment? [01] CO4
- 4 (b) What do you mean by power steering? [01] CO4
- 4 (c) What is the most commonly used suspension system in modern vehicles? [01] CO4
- 4 (d) Why and where do we use catalytic converter? [02] CO4
- 4 (e) Briefly describe a muffler in an automobile. [02] CO4
- 4 (f) With neat diagrams, explain the working of Ackerman steering mechanism. [08] CO4

OR

- 4 (f) Write a detailed note on exhaust emissions from diesel engines. How are they different from that of petrol engines? [08] CO4

2023-2024
B.TECH. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
ELECTRIC AND HYBRID VEHICLES
ME4291

Maximum Marks: 60

Credits: 04

Duration: Two Hours

Q.No.	Questions	CO	M.M.
1a.	Briefly explain the following EV components: i. Ultracapacitor ii. Flywheel iii. DC/DC convertor	CO1	[2+2+1]
1b.	What is the difference between a hybrid electric vehicle and Plug-in hybrid electric vehicle?	CO1	[2]
1c.	What parameters are used to compare an IC engine based vehicle with a battery electric vehicle. How do you compare the power and mileage of the two types of vehicles?	CO1	[8]
OR			
1c'.	How is a battery electric vehicle different from a hybrid electric vehicle? Explain the series and parallel hybrid vehicle configurations.	CO1	[8]
2a.	What are the main components of an electric vehicle?	CO2	[3]
OR			
2a'.	Explain the various possible EV configurations.	CO2	[3]
2b.	What are the different types of an electric vehicle?	CO2	[4]
2c.	Explain the traction motor characteristics of an electric vehicle.	CO2	[4]
2d.	Explain the various measures for the safety of an electric vehicle.	CO2	[4]
3a.	What are the two advantages and two disadvantages of using Lithium-ion battery in an electric vehicle?	CO3	[3]
3b.	What is the importance of charging system in an electric vehicle? Explain the different types of electric vehicle charging system with its challenges?	CO3	[2+2]

OR

Contd.....20

3b'. Explain variable speed electric vehicle motor characteristic.	CO3	[4]
3c. Explain the different types of lead acid batteries.	CO3	[3]
OR		
3c'. What are different methods of battery recycling?	CO3	[3]
3d. What are the different energy storage systems? Explain the working principle of fuel cell with neat sketch?	CO3	[5]
OR		
3d'. Explain the different parameters of batteries.	CO3	[5]
4a. Name the two different types of permanent magnet machines.	CO4	[2]
4b. What magnetic property of a soft material is different from a hard material. Where in a motor are these two types of materials used?	CO4	[4]
4c. Name any two magnetic materials used in permanent magnet machines.	CO4	[2]
4d. Explain the construction and working of an Induction machine.	CO4	[7]
OR		
4d'. Explain the construction and working of a permanent magnet Brushless DC motor.	CO4	[7]

2023-24
 Mechanical Engineering Department
 Autumn Semester Exam
 MEE4440, Non-Traditional Machining

Maximum Time = 2 hours

Max. Marks = 60

- ✓ Answer all the questions.
- ✓ Assume suitable data if missing.
- ✓ Notations used have their usual meaning.
- ✓ Programmable calculators (with extra memory storage) are not permitted.

Q. No.	Questions	CO	Marks
1a	i Name the machine component that is used to control the mixing ratio in Abrasive Jet Machining (AJM).	CO1	1
	ii Which process is more economical for abrading and frosting glass as compared to etching and grinding?	CO1	1
	iii What is the mechanics of material removal in Electric Discharge Machining (EDM)?	CO1	1
1b	i The diameter of the nozzle is 1.0 mm and the jet velocity is 200 m/s. Find the volumetric flow rate (cm ³ /sec) of abrasive. If the mixing ratio is 0.2 and volumetric flow rate of carrier gas is 50 cm ³ /sec.	CO1	2
	ii What are the mechanisms through which material is removed from the workpiece in Ultrasonic Machining (USM)?	CO1	2
	iii Explain the function of catcher and intensifier in water jet machining.	CO1	2
OR			
	iii' Discuss the effect of following process parameters of USM on material removal rate (MRR). <ul style="list-style-type: none"> • Effect of static load on MRR • Effect of abrasive grain size on MRR 	CO1	2
1c	List the basic assumptions of Abrasive Jet Machining (AJM) and derive material removal model for AJM.	CO1	6
OR			
1c'	A cylindrical impression of 10 mm diameter and 1 mm deep is to be made on WC specimen. Feed force is constant and is equal to 5N. The average diameter of grains in slurry is 10 microns. Tool oscillates with an amplitude of 30 microns at 20 kHz. The abrasive and water ratio in the slurry is 1. The flow strength of WC workpiece is 7000 N/mm ² and that of the copper is 1500 N/mm ² . Calculate the time required to complete the job. Assume K1=0.3 K2 = 1.8 and K3=0.6. Make the assumption if necessary.	CO1	6
2a	i Why Electron Beam Machining (EBM) process is conducted in vacuum?	CO2	1

contd over 2.

- ii Can deionized water be used as a dielectric medium? CO2 1
- iii Write any one limitation of Plasma Arc Machining (PAM). CO2 1
- OR**
- iii' What is maximum temperature during Plasma Arc Machining (PAM)? CO2 1
-
- 2b i During drilling of holes in a workpiece (density = $76 \times 10^{-7} \text{ kg/mm}^3$) by Electron Beam Machining (EBM), an accelerating voltage of 150 kV is used. Determine the total range to which the electron can penetrate. CO2 2
- ii Name any two thermo-electrical non-traditional machining processes by which electrically non-conducting material can be machined. CO2 2
- OR**
- ii' Explain Lambert's law applicable to laser beam machining. CO2 2
- 2c A laser beam with power intensity of $0.8 \times 10^5 \text{ W/mm}^2$ falls on a tungsten sheet. Find out the time required for the surface to reach the melting temperature. The given thermal properties of tungsten are melting temperature = $3400 \text{ }^\circ\text{C}$, thermal conductivity = $2.15 \text{ W/cm-}^\circ\text{C}$, volume specific heat = $2.71 \text{ J/cm}^3\text{-}^\circ\text{C}$. Assume that 12% of the beam is absorbed. CO2 4
- 2d Explain working principle of Wire Electric Discharge Machining (WEDM) process. How is it advantageous over die sink Electric Discharge Machining (EDM) process? CO2 4
- OR**
- 2d' Draw schematic diagram of Plasma Arc Machining. Explain the mechanism of Plasma Arc Machining. CO2 4
- 3a i Can electrically non-conducting material be cut using Electrochemical Discharge Machining (ECDM) Process? CO3 1
- ii Which etchant is used for machining copper in chemical machining process? CO3 1
- iii Which gas is evolved during electrochemical machining (ECM) process? CO3 1
- OR**
- iii' Whether workpiece is made 'anode' or 'cathode' during electrochemical machining (ECM) process? CO3 1
- 3b i Determine volumetric removal rate of pure iron workpiece in an electrochemical machining process with a current of 2000 amp. The CO3 2

contd... 3.

gram atomic weight, valency, and density of Iron are 56 g, 2, and 7.8 g/cm³, respectively.

ii What is the purpose of auxiliary electrode in Electrochemical Discharge Machining (ECDM) Process? CO3 2

OR

ii' State the two Faraday's Laws of Electrolysis. CO3 2

3c With the help of a schematic diagram explain the working mechanism of chemical machining process. Write down all steps involved in this process. Explain cut and peel maskants and Photoresist Maskants. Write two applications and two limitations of the process. CO3 8

4a i How do we achieve directional control in Abrasive Water Jet machining? CO4 1

ii Ceramic balls are polished through machining process. CO4 1

iii Name any one finishing process that requires external control of finishing forces. CO4 1

4b i Discuss the mechanism of material removal through magnetorheological fluid. CO4 2

OR

i' Explain the method of product fabrication through selective laser sintering. CO4 2

ii Explain the working principle of Chemical-mechanical polishing (CMP) with a neat diagram. CO4 2

4c Derive mixing model and material removal rate for Abrasive Water Jet Machining (AWJM). CO4 8

OR

4c' Discuss ANY TWO of the following processes: CO4 8

- i. Electrochemical Grinding.
- ii. Fused deposition modelling.
- iii. Laser-assisted Micromachining.



2023-24
B.TECH. (ODD SEMESTER) EXAMINATION
MECHANICAL
DATA ANALYTICS USING PYTHON
ME4730

Maximum Marks: 60

Credits: 03

Duration: Two Hours

*Answer all the questions.**Assume suitable data if missing.**Notations used have their usual meaning.*

Q.No.	Questions	CO	M.M.
1a.	<p>What will be the output of the following codes?</p> <p>i. <code>s = "This is going to be final exam of Data Analytics using Python."</code> <code>s[-7:-1]</code></p> <p>ii. <code>print(7//2, '\n', 7%3)</code></p> <p>iii. <code>and = 5.6</code> <code>print(and/2)</code></p>	CO3	[1+1+1]
1b.	<p>i. Create a Python function within the code to calculate Fahrenheit temperature values if the input is a series of Celsius values provided in a row within a text file. Subsequently, call the function to obtain the output. ($F = 5/9 C + 32$)</p> <p>ii. Write a code to calculate the minimum values out of given values in a row as a input. Do check also if the input is a number or not before finding out the minimum value.</p>	CO3	[2+2]
1c.	<p>Create a set of 1000 values for a standard normal distribution with a mean of 10 and a standard deviation of 0.5. After generating these values as a NumPy array, your code should perform the following tasks:</p> <p>i. Plot a histogram on a chart and save it as a PDF file.</p> <p>ii. Perform a z-test to determine whether a given sample outcome with a mean of 12 belongs to the same source (values generated using normal distribution above), or not.</p>	CO3	[8]
OR			
1c'	<p>Consider a scenario where quality checks are conducted every hour on a production line, inspecting ten items. Using the random choice function, generate the number of defective items found in the range of 0 to 10 for 1000 checks. Upon creating this defective item data, execute the following actions:</p> <p>i. Plot a histogram on a chart and save it as a PDF file.</p> <p>ii. Generate sampling distributions for $n = 2$ and $n = 30$ for the mean number of defects found.</p>	CO3	[8]

contd...2.

- iii. Plot a normal curve and histogram for the generated sampling distributions to demonstrate the central limit theorem, indicating that as the sample size increases, the distribution tends towards a normal distribution.

2a. What will be the output of the following codes? CO4 [1+1+1]

- i.

```
import pandas as pd
d1 = pd.Series([4,7,-5,3], index = ["a","b","c","d"])
print(d1*2)
```
- ii.

```
import pandas as pd
import numpy as np
df = pd.DataFrame(np.random.choice([1,2,3], (2,3)), columns =list("ABC"))
print(df)
```
- iii.

```
import pandas as pd
import numpy as np
df = pd.DataFrame(np.random.choice([1,2,3], (5,4)), columns =list("ABCD"))
print(df.iloc[3:4,0:2])
```

2b. The amounts of a chemical compound 'y' that dissolved in 100 grams of water at various temperatures 'x' were recorded, as the data shown in the figure. Suppose these are given as 'data.csv' file. CO4 [2+2+8]

	A	B	C	D
1	x (°C)	Y (trial 1)	Y (trial 2)	Y (trial 3)
2	0	8	6	8
3	15	12	10	14
4	30	25	21	24
5	45	31	33	28
6	60	44	39	42
7	75	48	51	44

Perform the following on the given data.

- i. Read the file and convert the data as DataFrame.
- ii. Convert the data into two columns 'x' and 'y'.
- iii. Perform linear regression analysis using numpy and pandas on the given data and plot the given data as well as regression line using matplotlib.pyplot.

$$b_1 = \frac{n \sum_{i=1}^n x_i y_i - \left(\sum_{i=1}^n x_i \right) \left(\sum_{i=1}^n y_i \right)}{n \sum_{i=1}^n x_i^2 - \left(\sum_{i=1}^n x_i \right)^2} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^n (x_i - \bar{x})^2} \text{ and}$$

$$b_0 = \frac{\sum_{i=1}^n y_i - b_1 \sum_{i=1}^n x_i}{n} = \bar{y} - b_1 \bar{x}.$$

(Note:)

contd over 3.

OR

iii'. Perform one way ANOVA analysis using 'numpy' and 'pandas' to see if there is a significant effect of temperature on grams of chemical compound dissolved in 100 grams of water.

(Note:

Source	Sum of Squares	Degrees of freedom
Treatment	$SSA = n \sum_{i=1}^k (\bar{y}_{i.} - \bar{y}_{..})^2$	$(n-1)$, where n is no of treatments (levels of temperature)
Error	$SSE = SST - SSA$	$k(n-1)$, where k is no of observations on each level of treatment
Total	$SST = \sum_{i=1}^k \sum_{j=1}^n (y_{ij} - \bar{y}_{..})^2$	$(kn-1)$

)

3a. i. How to comment with multiple lines in Python? CO1 [1x3=3]
 ii. What type of language is python? Programming or scripting?
 iii. Do we need to declare variables with respective data types in Python?

3b. i. What is scope resolution in Python? CO1 [2+2]
 ii. What are the common built-in data types in Python?

3c. Write a Python program to check whether a given string is a palindrome or not, without using an iterative method? CO1 [8]

OR

3c'. Write a program in Python to execute the Bubble sort algorithm? CO1 [8]

4a. i. Why do we need Scipy in python? CO2 [1+1+1]
 ii. Why would you use NumPy arrays instead of lists in Python?
 iii. What is the difference between / and // operator in Python?

4b. i. Explain all file processing modes supported in Python? CO2 [2+2]
 ii. Differentiate between NumPy and SciPy?

4c. Write a program in Python using NumPy to multiply two matrices? CO2 [8]