K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
FIRST INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

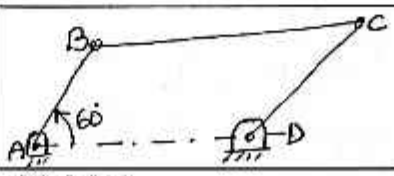
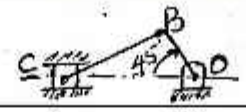
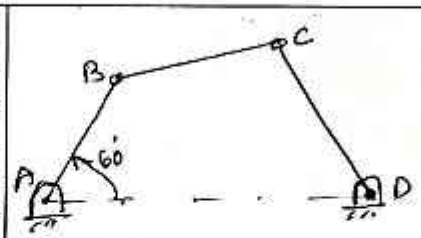
SET: A

USN | | | | | | | | | | |

Degree	: **B.E**	**Semester**	: **V**
Branch - Stream	: **MECHANICAL**	**Course Type / Code**	: **THEORY/21ME51**
Course Title	: **THEORY OF MACHINES**	**Date**	: **2/1/2024**
Duration	: **60 Minutes**	**Max Marks**	: **20**

Note: Answer **ONE full** question from each Module.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	Module-1			
1(a)	**Define** i) kinematic pair ii) kinematic chain iii)degree of freedom iv)machine	4	CO1	K2
(b)	**Make use of** contact between the links and type of motion between the links to classification of kinematic pairs	8	CO1	K3
	OR			
2(a)	**Define** i)mechanism ii)inversion iii)lower pair & Higher pair iv)mechanism	4	CO1	K2
(b)	In a 4 bar kinematic chain ABCD, AD is fixed and is 150mm long, the crank AB is 40mm long and rotates at 120 rpm CW, while the link CD-80mm oscillates about D. BC and AD are of equal length. **Solve** the angular velocity of link CD when BAD=60° 	8	CO1	K3
	Module-2			
3(a)	Explain static equilibrium conditions for the following i) Body subjected to two forces ii) body subjected to three forces iii)Body subjected to two forces and torque	4	CO2	K2
(b)	The crank of slider crank mechanism rotates CW at a constant speed of 300 rpm. The crank is 150mm and connecting rod is 600mm ling. **Determine** linear velocity of the piston 	4	CO2	K3
	OR			
4(a)	Explain tangential and radial component of acceleration.	4	CO2	K2
(b)	In a 4 bar mechanism ABCD , is made up of four links, pin jointed at the ends AD is fixed link, which is 180mm long, the links AB, BC, and CD are 90mm, 120mm and 120mm long respectively. At certain instant the link AB makes an angle of 60° with the link AD. If the link AB rotates at uniform speed of 100 rpm CW **determine** i) angular velocity of the link BC and CD 	4	CO2	K3

Name & Signature of Course In charge	Name & Signature of Module Coordinator	HOD	Principal

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
FIRST INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

SCHEME

SET: A

USN | | | | | | | | | | |

Degree	:	B.E	Semester	:	V
Branch - Stream	:	MECHANICAL	Course Type / Code	:	THEORY/21ME51
Course Title	:	THEORY OF MACHINES	Date	:	2/1/2024
Duration	:	60 Minutes	Max Marks	:	20

Note: Answer **ONE full** question from each Module.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks
1(a)	I)kinematic pair – 1mark ii) kinematic chain – 1mark iii)degree of freedom – 1mark iv)machine – 1mark	4
(b)	lower pair- 2marks higher pair – 2marks kinamtic pairs based on relative motion- 4marks	8
2(a)	i)mechanism- 1mark ii)inversion-1mark iii)lower pair & Higher pair -1mark iv)mechanism-1mark	4
(b)	4 bar kinematic chain space diagram- 2 mark velocity of the crank-2 marks velocity diagram- 2marks angular velocity of link CD 2marks	8
3(a)	Definition of static equilibrium -1 mark i) Body subjected to two forces- 1 mark ii) body subjected to three forces – 1mark iii) Body subjected to two forces and torque- 1mark	4
(b)	Slider crank mechanism space diagram- 2 mark velocity of the crank-2 marks velocity diagram- 2marks linear velocity of piston 2marks	4
4(a)	Tangential component of acceleration-2 marks Radial component of acceleration- 2marks	4
(b)	4 bar mechanism ABCD , space diagram- 2 mark velocity of the crank-2 marks velocity diagram- 2marks angular velocity of the link BC and CD-2marks	4

Name & Signature
of Course In charge

HOD

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
FIRST INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

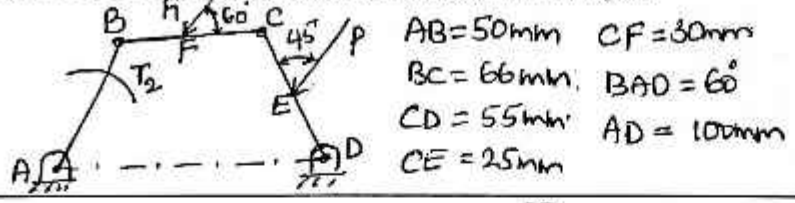
SET: B

USN | | | | | | | | | |

Degree	: B.E	Semester	: V
Branch - Stream	: MECHANICAL	Course Type / Code	: THEORY/21ME51
Course Title	: THEORY OF MACHINES	Date	: 2/1/2024
Duration	: 60 Minutes	Max Marks	: 20

Note: Answer **ONE full** question from each Module.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	Module-1			
1(a)	**Differentiate** between machine and mechanism	4	CO1	K2
(b)	**Explain** classification of kinematic inversions of 4 bar kinematic chain	8	CO1	K2
	OR			
2(a)	**Define** i)mechanism ii)inversion iii)lower pair & Higher pair iv)DOF	4	CO1	K3
(b)	Explain the procedure to follow velocity and acceleration analysis of 4 bar kinematic chain with an example	8	CO1	K3
	Module-2			
3(a)	Define static equilibrium and Explain static equilibrium conditions for the following i) Body subjected to two forces ii) body subjected to three forces	4	CO2	K3
(b)	Draw the FBD of all the movable links shown in the figure 	4	CO2	K3
	OR			
4(a)	Explain tangential and radial component of acceleration.	4	CO2	K3
(b)	In a 4 bar mechanism ABCD , is made up of four links, pin jointed at the ends AD is fixed link, which is 180mm long, the links AB, BC and CD are 90mm, 120mm and 120mm long respectively. At certain instant the link AB makes an angle of 60° with the link AD. If the link AB rotates at uniform speed of 100 rpm CW determine i) angular velocity of the link BC abd CD	4	CO2	K3

Name & Signature of Course In charge

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K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
FIRST INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

SCHEME

SET: B

USN | | | | | | | | | | |

Degree	:	B.E	Semester	:	V
Branch - Stream	:	MECHANICAL	Course Type / Code	:	THEORY/21ME51
Course Title	:	THEORY OF MACHINES	Date	:	2/1/2024
Duration	:	60 Minutes	Max Marks	:	20

Note: Answer **ONE full** question from each Module.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks
1(a)	4 differences between machine and mechanism – 4x1 4 mark	4
(b)	lower pair- 2marks higher pair – 2marks kinamtic pairs based on relative motion- 4marks	8
2(a)	i)mechanism- 1mark ii)inversion- 1mark iii)lower pair & Higher pair – 1mark iv)DOF- 1mark	4
(b)	procedure velocity analysis of 4 bar mechanisms- 4marks acceleration analysis of 4 bar mechanisms- 4marks	8
3(a)	static equilibrium -1 mark i) Body subjected to two forces –sketch 0.5 mark, explantion-1 mark ii) body subjected to three forces–sketch 0.5 mark, explantion-1 mark	4
(b)	FBD of all the movable links	4
4(a)	tangential component of acceleration- 2marks radial component of acceleration- 2marks	4
(b)	4 bar mechanism ABCD , space diagram- 1 mark velocity of the crank-1 marks velocity diagram- 1marks angular velocity of the link BC and CD-1marks	4

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K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
SECOND INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

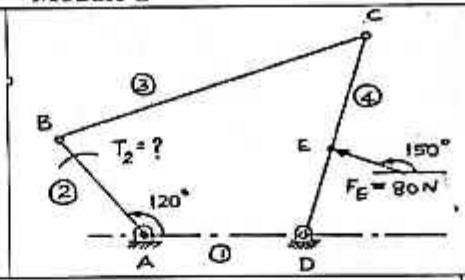
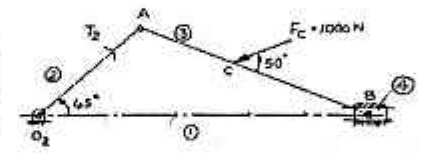
SET: A

USN | | | | | | | | | | |

Degree	**: B.E**	**Semester**	**: V**
Branch - Stream	**: MECHANICAL**	**Course Type / Code**	**: THEORY/21ME51**
Course Title	**: THEORY OF MACHINES**	**Date**	**: 5/2/2024**
Duration	**: 60 Minutes**	**Max Marks**	**: 20**

Note: Answer **ONE full** question from each Module.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	Module-1			
1(a)	Make use of involute profile to develop an expression for length of path of contact.	4	CO3	K2
(b)	Each of two gears in a mesh has 48 teeth and a module of 8 mm. The teeth are of 20° involute profile. The arc of contact is 2.25 times the circular pitch. Solve for the addendum.	8	CO3	K3
	OR			
2(a)	Develop an expression for Law of Gearing with a neat sketch	4	CO3	K3
(b)	Two involute gears in a mesh have a module of 8 mm and a pressure angle of 20°. The larger gear has 57 while the pinion has 23 teeth. If the addenda on pinion and gear wheels are equal to one module, **solve** for (i) contact ratio (ii) angle of action of the pinion and the gear wheel (iii) ratio of the sliding to rolling velocity at the	8	CO3	K3
	Module-2			
3(a)	A four link mechanism is acted upon by forces as shown in the figure. **Determine** the torque T_2 to be applied on link 2 to keep the mechanism in equilibrium. AD=50mm, AB=40mm, BC=100mm, Dc=75mm, DE= 35mm 	4	CO2	K3
(b)	Explain the terms in governor i)Height of the Governor ii)minimum and maximum equilibrium speed	4	CO4	K2
	OR			
4(a)	**Determine** T_2 to keep the mechanism shown in the figure in equilibrium, AC=70mm,AB=150mm, O2A= 40mm 	4	CO2	K3
(b)	Explain the terms in governor i)isochronous governor ii)Hunting	4	CO4	K2

01/02/24
Name & Signature of Course In charge

CHA-NAGABHUSHANA
Name & Signature of Module Coordinator

HOD

Principal

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
SECOND INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

SCHEME

SET: A

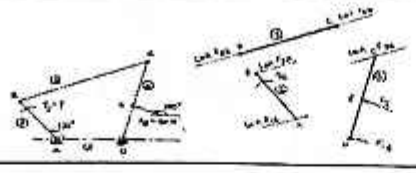
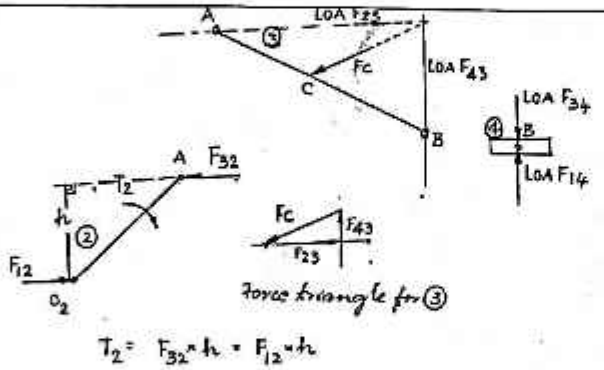
USN | | | | | | | | | | |

Degree	:	B.E	Semester	: V
Branch - Stream	:	MECHANICAL	Course Type / Code	: THEORY/21ME51
Course Title	:	THEORY OF MACHINES	Date	: 5/2/2024
Duration	:	60 Minutes	Max Marks	: 20

Note: Answer ONE full question from each Module.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks
1(a)	Path of contact = path of approach + path of recess $CD = CP + PD$ ---------- *2+2 Marks* $(\sqrt{R_a^2 - R^2\cos^2\varphi} - R\sin\varphi)$ —————— $+(\sqrt{r_a^2 - r^2\cos^2\varphi} - r\sin\varphi)$ ——————	4
(b)	*Solution* $\varphi = 20°$; $t = T = 48$; $m = 8$ mm; $R = r = \frac{mT}{2} = \frac{8\times48}{2} = 192$ mm; $R_a = r_a$ Arc of contact = 2.25 × Circular pitch = 2.25π m $\quad P_c = \pi D/T$ $= 2.25\pi \times 8 = 56.55$ mm Path of contact = $56.55 \times \cos 20° = 53.14$ mm or $(\sqrt{R_a^2 - R^2\cos^2\varphi} - R\sin\varphi)$ $+(\sqrt{r_a^2 - r^2\cos^2\varphi} - r\sin\varphi) = 53.14$ or $2(\sqrt{R_a^2 - 192^2\cos^2 20°} - 192\sin 20°)$ $= 53.14$ or $R_a = 202.6$ mm Addendum = $R_a - R = 202.6 - 192 = 10.6$ mm	2+2 +4
2(a)	sketch - 2MARKS expression for Law of Gearing-2MARKS	4
(b)	length of path of contact=52.3mm arc of contact =55.6mm contact ratio.=1.5	8

3(a)	i) 	4
(b)	Each definition is of 2 marks	4
4(a)	 $T_2 = F_{32} \times h = F_{12} \times h$ F_{32} and F_{12} form a CCW couple and hence T_2 acts clock wise.	4
(b)	Each definition is of 2 marks	4

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K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
SECOND INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

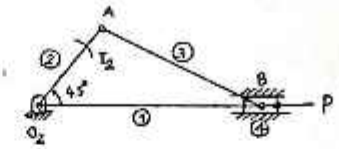
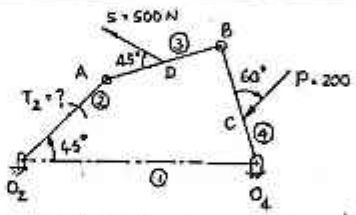
SET: B

USN | | | | | | | | | | |

Degree	: B.E	Semester	: V
Branch - Stream	: MECHANICAL	Course Type / Code	: THEORY/21ME51
Course Title	: THEORY OF MACHINES	Date	: 5/2/2024
Duration	: 60 Minutes	Max Marks	: 20

Note: Answer **ONE full** question from each Module.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	Module-1			
1(a)	Make use of involute profile to develop an expression for length of path of contact.	4	CO3	K3
(b)	Two involute gears in a mesh have a module of 8 mm and a pressure angle of 20°. The larger gear has 57 while the pinion has 23 teeth. If the addenda on pinion and gear wheels are equal to one module, solve for (i) contact ratio (ii) angle of action of the pinion and the gear wheel (iii) ratio of the sliding to rolling velocity at the(a) beginning of contact (b) pitch point (c) end of contact	8	CO3	K3
	OR			
2(a)	Compare Cycloidal and involute gear toot profile	4	CO3	K3
	A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Solve for length of path of contact, arc of contact and the contact ratio.	8	CO3	K3
	Module-2&4			
3(a)	Figure shows a slider crank mechanism in which the resultant gas pressure 8 x 10^4 Nm^{-2} acts on the piston of cross sectional area 0.1 m^2. The system is kept in equilibrium as a result of the couple applied to the crank 2, through the shaft at O_2. **Determine** forces acting on all the links (including the pins) and the couple on 2. 	4	CO2	K3
(b)	Explain the terms in governor i)Height of the Governor ii)minimum and maximum equilibrium speed	4	CO4	K2
	OR			
4(a)	**Determine** the torque T_2 required to keep the given mechanism in equilibrium. O_2A= 30mm, = AB =O_4B, O_2O_4 =60mm, $\angle O2O_4 = 60°$, BC = 19mm, AD=15mm 	4	CO2	K3
(b)	Explain the terms in governor :i))isochronous governor ii)Hunting	4	CO4	K2

01/02/24
Name & Signature of Course

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K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
SECOND INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

SCHEME

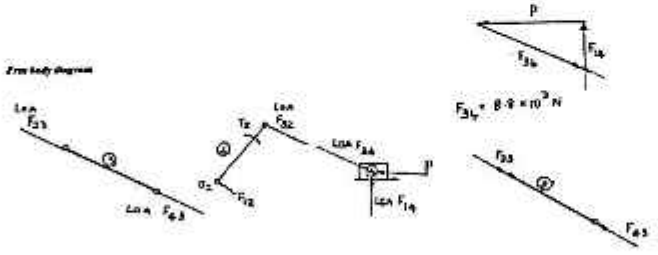
SET: B

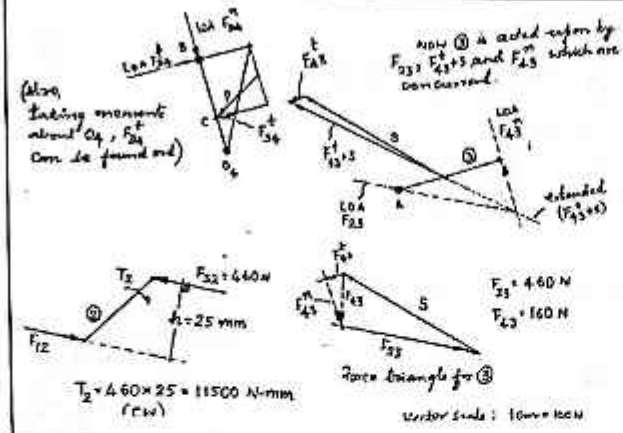
USN | | | | | | | | | | |

Degree	:	**B.E**	**Semester**	:	**V**
Branch - Stream	:	**MECHANICAL**	**Course Type / Code**	:	**THEORY/21ME51**
Course Title	:	**THEORY OF MACHINES**	**Date**	:	**5/2/2024**
Duration	:	**60 Minutes**	**Max Marks**	:	**20**

Note: Answer **ONE full** question from each Module.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks
1(a)	Path of contact = path of approach + path of recess *CD = CP + PD-2+2 marks* $(\sqrt{R_a^2 - R^2\cos^2\varphi} - R\sin\varphi)$ —————— $+(\sqrt{r_a^2 - r^2\cos^2\varphi} - r\sin\varphi)$ ——————	4
(b)	contact ratio = *1.68 (ii) angle of action of the pinion and the gear wheel= *10.63° (iii) ratio of the sliding to rolling velocity at the (a) beginning of contacT= =0.32 (b) pitch point=0 (c) end of contact= *0.287	8
2(a)	Cycloidal and involute gear toot profile	4
(b)	length of path of contact-2 arc of contact contact ratio.	8
3(a)		4
(b)	Each definition is of 2marks	4

4(a)		4
(b)	Each definition is of 2marks	4

Name & Signature of Course In charge

HOD

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
THIRD INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

SET: A

USN | | | | | | | | | | |

Degree	:	B.E	Semester	:	V
Branch - Stream	:	ME-ME	Course Type / Code	:	Theory/21ME51
Course Title	:	THEORY OF MACHINES	Date	:	04.03.2024
Duration	:	60 Minutes	Max Marks	:	20

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	Develop differential equation for a spring mass damper system	4	CO5	K3
(b)	A vibrating system consists of mass 25 kg, a spring of stiffness 15 kN/m and a damper. The damping provided is only 15% of critical value. Determine i) Critical damping coefficient ii) damping factor iii)natural frequency iv) logarithmic decrement v) ration of two consecutive amplitudes of vibration	8	CO5	K3
	OR			
2(a)	A body of mass 5kg is supported on a spring of stiffness 1960N/m and has a dashpot connected to it which produces a resistance of 1.96N at a velocity of 1m/s in what ratio will the amplitude of vibration be reduced after 5 cycles	6	CO5	K3
(b)	Develop differential equation for a spring mass damper system and obtain complete solution for over damped system	6	CO5	K3
	PART –B			
3(a)	In an engine governor of porter type, the upper and lower arms are 200mm and 250mm respectively and pivoted on the axis of rotation. The mass of central load is 15kg, the mass of each ball is 2kg and friction at the sleeve together with the resistance of the operating gear is equal to a load of 24N at the sleeve. If the limiting inclinations of the upper arms to the verticals are 30^0 and 40^0. Solve taking friction in to account range of speed of the governor.	8	CO4	K3
	OR			
4(a)	In a hartnell governor, the extreme radii of rotation of the balls are 40mm and 60mm and corresponding speeds are 210rpm and 230rpm. The mass of each ball is 3 kg. The ball and sleeve arms are equal. Determine i) spring loads at min and max speeds ii) stiffness of the spring iii)initial compression of the spring	8	CO4	K3

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Name & Signature of Module Coordinator:

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THIRD INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

SET: B

USN | | | | | | | | | |

Degree	:	B.E	Semester	: V
Branch - Stream	:	ME-ME	Course Type / Code	: Theory/21ME51
Course Title	:	THEORY OF MACHINES	Date	: 04.03.2024
Duration	:	60 Minutes	Max Marks	: 20

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks
1(a)	$x = e^{-\beta t}(A_1 + A_2 t)$	4
(b)	logarithmic decrement=0.6105-3Marks ratio of any two consecutive amplitudes of a vibrating system =1.84-3Marks number of cycles :2.63-2Marks	8
2(a)	logarithmic decrement=0.63-3Marks ratio of any two consecutive amplitudes of a vibrating system =6.62-3Marks	6
(b)	$x(t) = c_1 e^{\left(-\zeta+i\sqrt{1-\zeta^2}\right)\omega_n t} + c_2 e^{\left(-\zeta-i\sqrt{1-\zeta^2}\right)\omega_n t}$ $= e^{-\zeta\omega_n t}\left[a_1\cos(\omega_d t) + a_2\sin(\omega_d t)\right]$ $\Rightarrow x(t) = \underbrace{e^{-\zeta\omega_n t}}_{\text{Exponentially decay}}\underbrace{\left[a_1\cos(\omega_d t) + \frac{a_2 + \zeta\omega_n a_1}{\omega_d}\sin(\omega_d t)\right]}_{\text{Periodic motion}}$	6
3(a)	N=167 rpm-2marks N1=164.8rpm-2marks N2=169rpm-2 marks N2-N1=4.2rpm- 2 marks	8
4(a)	s1=562N- 2marks s2=930N- 2marks k=9.2N/mm-2 marks initial compression=9.2N/mm- 2marks	8

01/03/24

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Course In charge:

HOD

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
THIRD INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

SET: B

USN | | | | | | | | | | |

Degree	:	B.E	Semester	:	V
Branch - Stream	:	ME-ME	Course Type / Code	:	Theory/21ME51
Course Title	:	THEORY OF MACHINES	Date	:	04.03.2024
Duration	:	60 Minutes	Max Marks	:	20

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	Develop differential equation for a spring mass damper system	4	CO5	K3
(b)	Find logarithmic decrement, ratio of any two consecutive amplitudes of a vibrating system and number of cycles after which the original amplitude is reduced to 20%. The vibrating system is defined by the following parameters m=3.5kg, k-2.5N/mm, c=0.018Ns/m	8	CO5	K3
	OR			
2(a)	A vibrating system in a vehicle is to be designed with the following parameters k=100N/m, c=2Ns/m, m=1kg. calculate the decrease in amplitude after 3 complete oscillations and frequency of oscillation	6	CO5	K3
(b)	Develop differential equation for a spring mass damper system and obtain complete solution for over damped system	6	CO5	K3
	PART –B			
3(a)	The arms of a porter governor are 300mm long. The upper arms are pivoted on the axis of revolution. The lower arms are attached to the sleeve at a distance of 40mm from the axis of rotation. The mass of the load on the sleeve is 70kg and mass of each ball is 10kg. **Find** the equilibrium speed when the radius of rotation of the ball is 200mm. If the friction is equivalent to 20N at the sleeve, what will be the range of speed for this position?.	8	CO4	K3
	OR			
4(a)	In a spring loaded Hartnell type governor, the extreme radii of rotation of the balls are 80 mm and 120 mm. The ball arm and the sleeve arm of the bell crank lever are equal in length. The mass of each ball is 2 kg. If the speeds at the two extreme positions are 400 and 420 r.p.m., find: 1. the initial compression of the central spring, and 2. the spring constant.	8	CO4	K3

01/03/24
Name & Signature of Course In charge:

Name & Signature of Module Coordinator:

HOD

Principal

Selected.

K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
THIRD INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

SCHEME

SET: A

USN | | | | | | | | | | |

Degree	: **B.E**	**Semester**	: **V**
Branch - Stream	: **ME-ME**	**Course Type / Code**	: **Theory/21ME51**
Course Title	: **THEORY OF MACHINES**	**Date**	: **04.03.2024**
Duration	: **60 Minutes**	**Max Marks**	: **20**

Note: Answer **ONE full** question from each part.

K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks
1(a)	$x = e^{-\zeta t}(A_1 + A_2 t)$	4
(b)	i) Given data-1Marks ii) Critical damping coefficient=1224.7Ns/m-1Marks iii) damping factor =0.15-1Marks iv) natural frequency =24.22rad/s-1Marks v) logarithmic decrement =0.9533-1Marks vi) ration of two consecutive amplitudes of vibration=2.594 -2Marks	8
2(a)	c=1.96Ns/m-2Marks cc=197.99Ns/m-2Marks logarithmic decrement:0.0622-2Marks x0/x5=1.365-2Marks	6
(b)	$x(t) = c_1 e^{\left(-\zeta + i\sqrt{1-\zeta^2}\right)\omega_n t} + c_2 e^{\left(-\zeta - i\sqrt{1-\zeta^2}\right)\omega_n t}$ $= e^{-\zeta\omega_n t}\left[d_1 \cos(\omega_d t) + d_2 \sin(\omega_d t)\right]$ $\Rightarrow x(t) = \underbrace{e^{-\zeta\omega_n t}}_{\text{Exponentially decay}} \underbrace{\left[x_0 \cos(\omega_d t) + \frac{v_0 + \zeta\omega_n x_0}{\omega_d} \sin(\omega_d t)\right]}_{\text{Periodic motion}}$	6
3(a)	$N_1 = 183.3$ r.p.m. $N_2 = 222$ r.p.m. $N_2 - N_1 = 222 - 183.3 = 38.7$ r.p.m. Ans.	8
4(a)	i) spring loads at min and max speeds i) stiffness of the spring-4 markd ii) iii)initial compression of the spring-4marks	8

01/03/24

Name & Signature of Course In charge: :

HOD