Q. Code: 258014

Reg. No. | | | | | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Third Semester

MN22302 – THEORY OF MACHINES

(Mechanical Engineering)

(Regulation 2022)

TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Analyze the kinematics of given mechanism by relative velocity method.	**4**
CO 2	Calculate the characteristics parameters of various gears and performance of epicyclic gear trains.	**3**
CO 3	Evaluate the dynamic forces acting on the elements of slider crank mechanisms.	**3**
CO 4	Analyze and solve the unbalancing forces in masses rotating in different planes.	**4**
CO 5	Calculate the natural frequency of vibrating bodies under various vibratory motions.	**3**

PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	With an example, explain inversion of a mechanism.	**1**	**2**
2.	Comment on the degree of freedom and mobility of a mechanism.	**1**	**2**
3.	Differentiate mechanical pair and a kinematic pair.	**1**	**2**
4.	Comment the type of pairs with Point contact, line contact and surface contact.	**1**	**2**
5.	Illustrate pitch circle diameter of a gear in a sketch.	**2**	**2**
6.	Explain the path of approach of two mating gears.	**2**	**2**
7.	When does mating gears become a gear train?	**2**	**2**
8.	Why should interference to be avoided in gears?	**2**	**2**
9.	With simple sketch, explain the forces acting in a piston and connecting rod of an I.C engine.	**3**	**2**
10.	Why is a flywheel significant in machines requiring continuous supply of energy?	**3**	**2**

11.	Explain how D'Alembert's principle is useful in dynamic force analysis.		**3**	**2**
12.	With a neat sketch, explain turning moment diagram.		**3**	**2**
13.	Explain the need for balancing of masses on different planes.		**4**	**2**
14.	Why should the reciprocating masses be balanced?		**4**	**2**
15.	What is a hammer blow?		**4**	**2**
16.	Why should swaying couple be avoided in locomotives?		**4**	**2**
17.	Why should vibration to be arrested?		**5**	**2**
18.	Differentiate free and forced vibration.		**5**	**2**
19.	Why is damping necessary?		**5**	**2**
20.	What is logarithmic decrement?		**5**	**2**

PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21. (a)	In a slider crank mechanism, crank is 12 cm and connecting rod is 50cm long. The crank rotates at 275 rpm in clockwise direction. Find the velocity of the slider and angular velocity of the connecting rod when the crank has turned 45°.	**(10)**	**1**	**4**
	(OR)			
(b)	A four-bar mechanism with links AB = 200mm, BC = 400mm, CD = 450mm and AD = 60 mm long is employed in an application. The crank AB rotates at 35 rad/s and the link AD was fixed. Find the velocity at the midpoint of BC when AB is at right angles to AD.	**(10)**	**1**	**4**
22. (a)	A gear with 24 teeth and involute profile, module 6mm and angle of	**(10)**	**2**	**3**

obliquity 20° is driving another gear of same dimensions. When addendum is equal to one module, calculate the length of arc of contact, path of contact.

(OR)

(b)	In the given gear train, gear A has 76 internal teeth and gear C has 36 external teeth. The gear B meshes with both A and C. The arm EF rotates about the centre of A at 16 r.p.m. Analyse the motion of the gear train and determine the speed of gears B and C, if the gear A is fixed,.	**(10)**	**2**	**3**

23. (a)	The crank-pin circle radius of a horizontal engine is 300 mm. The mass of the reciprocating parts is 250 kg. When the crank has travelled 60° from I.D.C., the difference between the driving and the back pressures is 0.35 N/mm^2. The connecting rod length between centres is 1.2 m and the cylinder bore is 0.5 m. If the engine runs at 250 r.p.m. and if the effect of piston rod diameter is neglected, calculate: 1. pressure on slide bars, 2. thrust in the connecting rod, 3. tangential force on the crank-pin, and 4. turning moment on the crank shaft.	**(10)**	**3**	**3**

(OR)

(b)	A riveting machine is driven by a constant torque 2.75 kW motor. The moving parts including the flywheel are equivalent to 145 kg at 0.75 m radius. One riveting operation takes 1.1 seconds and absorbs 10 kN-m of energy. The speed of the flywheel is 325 r.p.m. before riveting. Determine (i) the speed immediately after riveting and (ii) the number of rivets that could be closed per minute.	**(10)**	**3**	**3**

24. (a)	Four masses A, B, C and D are carried in parallel planes in this order along its length. The masses at B and C are 16 kg and 10 kg respectively, and each has an eccentricity of 50 mm. The masses at A and D have an eccentricity of 75 mm. The angle between the masses at B and C is 110° and that between the masses at B and A is 200°, both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance,	**(10)**	**4**	**4**

determine (i) The magnitude of the masses at A and D (ii) the distance between planes A and D (iii) the angular position of the mass at D.

(OR)

(b)	A shaft carries five masses A, B, C, D and E which revolve at the same radius in planes which are equidistant from one another. The magnitude of the masses in planes A, C and D are 52 kg, 43 kg and 85 kg respectively. The angle between A and C is 90° and that between C and D is 135°. Determine the magnitude of the masses in planes B and E and their positions to put the shaft in complete rotating balance.	**(10)**	**4**	**4**
25. (a)	A simply supported shaft of length 0.75 m carries a load of 2 kg at its midspan. The density of the shaft material 1100 kg/m^3 and Young's modulus is 200 GN/m^2. Calculate the whirling speed of the shaft.	**(10)**	**5**	**3**

(OR)

(b)	A mechanical system with mass 20 kg is supported by springs with combined equivalent spring of stiffness 5.4 N/mm. If the vibrating system have a dashpot attached which exerts a force of 50 N when the mass has a velocity of 2 m/s, find (i) critical damping coefficient, (ii) damping factor, (iii) Logarithmic decrement, (iv) ratio of two consecutive amplitudes.	**(10)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	A simply supported shaft 1.5 m long carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 0.4m from the centre towards left. The shaft is hollow of external diameter 60 mm and internal diameter 28 mm. The density of the shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the frequency of transverse vibration of the shaft, considering the mass of the shaft.	**(5)**	**5**	**3**

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