Q.5	i.	What do you mean by static and dynamic balancing of machines?	**3**
	ii.	A four cylinder vertical engine has cranks 150 mm long. The planes of rotation of the first, second and fourth cranks are 400 mm, 200 mm and 200 mm respectively from the third crank and their reciprocating masses are 50 kg, 60 kg and 50 kg respectively. Find the mass of the reciprocating parts for the third cylinder and the relative angular positions of the cranks in order that the engine may be in complete primary balance.	**7**
OR	iii.	A shaft carries four rotating masses A, B, C and D which are completely balanced. The masses B, C and D are 50 kg, 80 kg and 70 kg respectively. The masses C and D make angles of 90° and 195° respectively with mass B in the same sense. The masses A, B, C and D are concentrated at radius 75 mm, 100 mm, 50 mm and 80 mm respectively. The plane of rotation of masses B and C are 250 mm apart. Determine (i) the magnitude of mass A and its angular position and (ii) the position planes A and D.	**7**
Q.6	i.	What do you mean by uniform pressure and uniform wear theories? Explain in brief.	**3**
	ii.	In a thrust bearing, the external and internal diameters of the contacting surfaces are 320 and 200 mm repectively.the total axial load is 80 kN and intensity of pressure is 350 kN/mm^2. Shaft rotates at 400rpm, Find the power lost in friction and number of collars required, if coefficient of friction is 0.06.	**7**
OR	iii.	A single plate clutch transmits 25 kW at 900 rpm.The intensity of pressure is limited to 85kN/mm^2.The external diameter of plate is360 mm.both the sides of the plate are effective and coefficient of friction is 0.25.Determine the inner diameter of plate and axial force to engage clutch.	**7**

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Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering

End Sem (Even) Examination May-2018

ME3CO10 Dynamics of Machines

Programme: B.Tech. Branch/Specialisation: ME

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1	i.	D'Alembert's principle is used for (a) Reducing problem of kinetics to equivalent statics problem (b) Determining stresses in the structures (c) Solving kinematics problem (d) Designing safe structures.	**1**
	ii.	The essential condition of placing the two masses, so that the system becomes dynamically equivalent, is (where l_1 and l_2 = Distance of two masses from the centre of gravity of the body, and k_G = Radius of gyration of the body) (a) $l_1 = k_G$ (b) $l_2 = k_G$ (c) $l_1 l_2 = k_G$ (d) $l_1 l_2 = k_G^2$	**1**
	iii.	The coefficient of fluctuation of energy is (a) Sum of maximum and minimum energies (b) Difference between the maximum and minimum energies (c) Ratio of the maximum energy and minimum energy (d) Ratio of the maximum fluctuation of energy to the work done per cycle	**1**
	iv.	Mean resisting torque in Turning Moment diagram is given by (a) Work done per cycle/Angle turned during the cycle (b) Work done per cycle x Angle during the cycle (c) Work done per revolution /Angle during the cycle (d) None of these	**1**

P.T.O.

v. Effort of a governor is the **1**
(a) Mean force exerted at the sleeve for a given percentage change of speed
(b) Work done at the sleeve for maximum equilibrium speed
(c) Mean force exerted at the sleeve for maximum equilibrium speed
(d) None of these

vi. If the controlling force line for a spring controlled governor when produced intersects the Y-axis at the origin, then the governor is said to be **1**
(a) Stable (b) Unstable
(c) Isochronous (d) None of these

vii. Which one of the following can completely balance several masses revolving in different planes on a shaft? **1**
(a) A single mass in different planes
(b) Two masses in any two planes
(c) C.A single mass in one of the planes of the revolving asses
(d) Two equal masses in any two planes

viii. Calculate the thrust in connecting rod, if piston effort is 200 kN and connecting rod makes an angle of 45o with the line of stroke.
(a) 900.80 kN (b) 204.20 kN (c) 282 kN (d) 141.84 kN

ix. The frictional torque transmitted by a disc or plate clutch is same as that of **1**
(a) Flat pivot bearing (b) Flat collar bearing
(c) Conical pivot bearing (d) Truncated conical pivot bearing

x. Which of the following condition is true for uniform wear theory?
(a) p = constant (b) p/r = constant
(c) p.r = constant (d) $p.r^2$ = constant

Q.2 i. State the principle of superposition. **2**

ii. What are the condition for a body to be in equilibrium under the action of two forces, three forces and two forces and a torque? **3**

iii. What do you mean by dynamical equivalent system? Explain. **5**

OR iv. Describe the graphical method of considering the inertia of connecting rod of a reciprocating engine. **5**

Q.3 i. Define crank effort in an engine. **2**

ii. Why is flywheel necessary in a punching press? **3**

iii. Find the work done per cycle for an engine whose torque curve is given by T = (25000 + 5000 sin 2θ – 10000 cos 2θ) Nm. **5**

OR iv In a reciprocating engine mechanism, if the crank and the connecting rod are 300 mm and 1 m long respectively and the crank rotates at a constant speed of 200 rpm. Determine analytically, (a) The crank angle at which the maximum velocity of piston occurs and (b) Maximum velocity of the piston. **5**

Q.4 i. When is a governor said to be 'hunting'? **2**

ii. The lengths of the upper and lower arms of a porter governor are 200 mm and 250 mm respectively. Both the arms are pivoted on the axis of rotation. The central load is 150 N, the weight of each ball is 20 N and the friction on the sleeve together with the resistance of the operating gear is equivalent to a force of 30 N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40°, determine the range of speed of the governor. **8**

OR iii. A Hartnell governor having a central sleeve spring and two right-angled bell crank levers moves between 290 r.p.m. and 310 r.p.m. for a sleeve lift of 15 mm. The sleeve arms and the ball arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from the governor axis and mass of each ball is 2.5 kg. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine : **8**
(a) Loads on the spring at the lowest and the highest equilibrium speeds, and
(b) Stiffness of the spring

Marking Scheme
ME3CO10 Dynamics of Machines

Q.1	i.	D'Alembert's principle is used for (a) Reducing problem of kinetics to equivalent statics problem	**1**
	ii.	The essential condition of placing the two masses, so that the system becomes dynamically equivalent, is (where l_1 and l_2 = Distance of two masses from the centre of gravity of the body, and k_G = Radius of gyration of the body) (d) $l_1 l_2 = k_G^2$	**1**
	iii.	The coefficient of fluctuation of energy is (d) Ratio of the maximum fluctuation of energy to the work done per cycle	**1**
	iv.	Mean resisting torque in Turning Moment diagram is given by (a) Work done per cycle/Angle turned during the cycle	**1**
	v.	Effort of a governor is the (a) Mean force exerted at the sleeve for a given percentage change of speed	**1**
	vi.	If the controlling force line for a spring controlled governor when produced intersects the Y-axis at the origin, then the governor is said to be (c) Isochronous	**1**
	vii.	Which one of the following can completely balance several masses revolving in different planes on a shaft? (b) Two masses in any two planes	**1**
	viii.	Calculate the thrust in connecting rod, if piston effort is 200 kN and connecting rod makes an angle of 45o with the line of stroke. (c) 282 kN	
	ix.	The frictional torque transmitted by a disc or plate clutch is same as that of (b) Flat collar bearing	**1**
	x.	Which of the following condition is true for uniform wear theory? (c) p.r = constant	

Q.2	i.	Statement principle of superposition with explanation		**2**
	ii.	Condition for equilibrium of two force members Condition for equilibrium of three force members Condition for equilibrium of two force and torque members	1 mark 1 mark 1 mark	**3**
	iii.	Explanation of dynamic equivalent system with diagram Three conditions for equivalent system each one marks (1 mark * 3)	2 marks 3 marks	**5**
OR	iv.	Klins Construction with configuration diagram Steps of construction	3 marks 2 marks	**5**
Q.3	i.	Definition of crank effort with expression		**2**
	ii.	Explanation of why we use of flywheel in a punching press with diagram.		**3**
	iii.	TMD Equation of work done Complete solution with result Ans = 78539.816W	1 mark 1 mark 3 marks	**5**
OR	iv	Given (a) The crank angle at which the maximum velocity of piston occurs (b) Maximum velocity of the piston.	1 mark 2 marks 2 marks	**5**
Q.4	i.	Definition of 'hunting'		**2**
	ii.	Diagram and details of Porter governor for Min. & Max. Position H1 = 0.173 Q1 = 0.75 H2=0.15 Q2 = 0.73 Formula for height of governor N1=179 , N2 = 225	2 marks 1 mark 1 mark 1 mark 1 mark 2 marks	**8**
OR	iii.	Given (a) Loads on the spring at the lowest and the highest equilibrium speeds (b) Stiffness of the spring	1 mark 5 marks 2 marks	**8**

Q.5	i.	Static balancing of machines	1.5 marks	**3**
		Dynamic balancing of machines	1.5 marks	
	ii.	Configuration diagram with end view	1 mark	**7**
		Table for force and couple	2 marks	
		Force and couple polygon	2 marks	
		Mass of 3 = 60 kg	1 mark	
		Position of cranck 2 = 160°		
		Position of cranck 3 = 227°		
		Position of cranck 2 = 26°	1 mark	
OR	iii.	Configuration diagram with end view	1 mark	**7**
		Table for force and couple	2 marks	
		Force and couple polygon		
		Mass of A = 34.7 kg & Ang. Position = 83.3°, 276.7	2 marks	
		Position of plane D = 230 mm or 20 mm from RP		
		Position of Plane A = 125 from c(BDCA)	2 marks	
Q.6	i.	Uniform pressure	1.5 marks	**3**
		Uniform wear	1.5 marks	
	ii.	Configuration diagram with notation	1 mark	**7**
		Using uniform pressure theory Pmax= load/Area	1 mark	
		Torque Eqn T = nμWRmean, where = 2/3((r13-r23)/r12-r22),		
		T=635N-m	3 marks	
		Power eqn P = Tw , P=26.6kw	2 marks	
OR	iii.	Configuration diagram with notation	1 mark	**7**
		Equation of power , Torque = 265N-m	1 mark	
		Max. Intensity EQn, Pr2=C using uniform wear theory	1 mark	
		Load Eqn W = 2πC(rl-r2)	1 mark	
		Torque Eqn T = nμWR	1 mark	
		Solution of cubical equation	2 marks	

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