P P SAVANI UNIVERSITY

Fifth Semester of B. Tech. Examination

December 2021

SEME3031 Dynamics of Machinery

09.12.2021, Thursday | Time: 09:00 a.m. To 12:30 p.m. | Maximum Marks: 60

Instructions:

1. The question paper comprises of two sections.
2. Section I and II must be attempted in separate answer sheets.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculator is allowed.

SECTION – I

Q - 1	Explain Velocity and acceleration of piston with Diagram	**[05]**
Q - 2 (a)	What is balancing ? Explain any one	**[03]**
Q - 2 (b)	The four masses A, B, C and D revolve at equal radii are equally spaces along the shaft. The mass B is 7 kg and radii of C and D makes an angle of 90° and 240° respectively (counterclockwise) with radius of B, which is horizontal. Find the magnitude of A, C and D and angular position of A so that the system may be completely balance. Solve problem by analytically.	**[07]**
	OR	
Q - 2 (a)	Prove that the maximum fluctuation of energy, $\Delta E_{max} = 2.E.C_s$ with usual notations.	**[03]**
Q - 2 (b)	A vertical petrol engine 100 mm diameter and 120 mm stroke has a connecting rod 250 mm long. The mass of the piston is 1.1 Kg. The speed is 2000 R.P.M. On the expansion stroke with a crank 200 from top dead centre, the gas pressure is 700 KN/mm2. Determine net force on the piston, resultant load on the gudgeon pin, thrust on the cylinder wall, speed above which other things remain same, the gudgeon pin load would be reverse in direction.	**[07]**
Q - 3 (a)	Explain D' Alembert Principle.	**[03]**
Q - 3 (b)	Explain Klain's Construction method.	**[07]**
	OR	
Q - 3 (a)	What are in-line engines ? How are they balanced ? It is possible to balance them completely ?	**[03]**
Q - 3 (b)	The data for three rotating masses are given below: M1=4kg r1=75mm 1=45 M2=3kg r2=85mm 2=135 M3=2.5kg r3=50mm 3=240 Determine the amount of counter mass at a radial distance of 65mm required for their static balance.	**[07]**
Q - 4	Attempt any one.	**[05]**
(i)	Draw Turning moment diagram for single cylinder four stroke engine and Explain.	
(ii)	What is the function of a flywheel? How does it differ from that of a governor?	

SECTION – II

Q - 1	Answer the Following (Any five)	**[05]**
(i)	Define, free vibrations,	
(ii)	Define damped vibrations	
(iii)	Discuss the effect of inertia of the shaft in longitudinal vibrations.	
(iv)	What do you understand by transmissibility ?	
(v)	Explain the term 'whirling speed' of a shaft.	
(vi)	What do you understand by gyroscopic couple ?	
(vii)	Define 'inertia force' and 'inertia torque'.	
Q - 2 (a)	Define the terms: Natural frequency, Damping, Resonance, and Simple Harmonic Motion	**[03]**
Q - 2 (b)	A horizontal cross compound steam engine develops 300 kW at 90 r.p.m. The coefficient of fluctuation of energy as found from the turning moment diagram is to be 0.1 and the fluctuation	**[07]**

of speed is to be kept within ± 0.5% of the mean speed. Find the weight of the flywheel required, if the radius of gyration is 2 metres

OR

Q - 2 (a)	Explain the terms 'under-damping', 'over-damping' and 'critical damping'	**[03]**
Q - 2 (b)	A vibrating system is defined by the following parameters: Mass m = 3kg, Spring Stiffness k = 100 N/m, Damping Coefficient c = 3 N-sec/m. Determine (i) Damping factor (ii) Natural frequency of damped vibration (iii) Logarithmic decrement (iv) Ratio of two consecutive amplitudes (v) Number of cycles after which the original amplitude is reduced to 20%.	**[07]**
Q - 3 (a)	Define and explain the following terms relating to governors : 1. Stability, 2. Isochronism, and 3. Hunting.	**[03]**
Q - 3 (b)	The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: 1. when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h. 2. when the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees	**[07]**

OR

Q - 3 (a)	What are the effects of friction and of adding a central weight to the sleeve of a Watt governor ?	**[03]**
Q - 3 (b)	The measurements on a mechanical vibrating system show that it has a mass of 8 kg and that the springs can be combined to give an equivalent spring of stiffness 5.4 N/mm. If the vibrating system have a dashpot attached which exerts a force of 40 N when the mass has a velocity of 1 m/s, find : 1. critical damping coefficient, 2. damping factor, 3. Logarithmic decrement, and 4. ratio of two consecutive amplitudes.	**[07]**
Q - 4	Attempt any one.	**[05]**
(i)	What do you mean by whirling of shaft? Why and where it is necessary to check the whirling speeds of shaft?	
(ii)	Plot the frequency response curve of harmonic force excitation for the various damping factors.	

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SECTION – I

Q - 1	Answer the Following (Any five)	**[05]**
(i)	What is the function of a flywheel?	
(ii)	What is inversion of mechanism ?	
(iii)	What is difference between machine and structure ?	
(iv)	What is lower and higher kinematic pair ?	
(v)	What is difference between flywheel and governor ?	
(vi)	What is the uses of turning moment diagram of reciprocating engines.	
(vii)	In a turning moment diagram, the variations of energy above and below the mean resisting torque line is called _____.	
Q - 2 (a)	Explain the terms static balancing and dynamic balancing.	**[03]**
Q - 2 (b)	A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance.	**[07]**

OR

Q - 2 (a)	Prove that the maximum fluctuation of energy, $\Delta E_{max} = 2.E.C_s$ with usual notations.	**[03]**
Q - 2 (b)	A vertical petrol engine 100 mm diameter and 120 mm stroke has a connecting rod 250 mm long. The mass of the piston is 1.1 Kg. The speed is 2000 R.P.M. On the expansion stroke with a crank 200 from top dead centre, the gas pressure is 700 KN/mm2. Determine net force on the piston, resultant load on the gudgeon pin, thrust on the cylinder wall, speed above which other things remain same, the gudgeon pin load would be reverse in direction.	**[07]**
Q - 3 (a)	Explain the Direct and Reverse Cranks Method of balancing radial engine.	**[03]**
Q - 3 (b)	A two cylinder locomotive has the following specifications; Reciprocating mass per cylinder = 300 Kg Crank radius = 300 mm Angle between cranks = 900 Driving wheels diameter = 1800 mm Distance between cylinder centres = 650 mm Distance between driving wheel planes = 1550 mm Determine : (a) The fraction of reciprocating masses to be balanced, if the hammer blow is not to exceed 46 KN at 96.5 Km / hr. (b) The variation in tractive force. (c) The maximum swaying couple.	**[07]**

OR

Q - 3 (a)	What are in-line engines ? How are they balanced ? It is possible to balance them completely ?	**[03]**
Q - 3 (b)	A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively, and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same	**[07]**

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, determine :
1. The magnitude of the masses at A and D ; 2. the distance between planes A and D ; and 3. the angular position of the mass at D.

Q - 4	Attempt any one.	[05]
(i)	Explain Primary and Secondary Unbalanced Forces of Reciprocating Masses	
(ii)	Derive the expressions of Hammer blow, for an uncoupled two cylinder locomotive engine.	

SECTION – II

Q - 1	Answer the Following (Any five)	[05]
(i)	Define, free vibrations,	
(ii)	Define damped vibrations	
(iii)	Natural frequency	
(iv)	Damping	
(v)	Resonance	
(vi)	Gyroscopic couple	
(vii)	Governor	
Q - 2 (a)	Derive the following expressions, for an uncoupled two cylinder locomotive engine: 1) Variation in tractive force; 2) Swaying couple; and 3) Hammer blow.	[03]
Q - 2 (b)	A horizontal cross compound steam engine develops 300 kW at 90 r.p.m. The coefficient of fluctuation of energy as found from the turning moment diagram is to be 0.1 and the fluctuation of speed is to be kept within ± 0.5% of the mean speed. Find the weight of the flywheel required, if the radius of gyration is 2 metres	[07]

OR

Q - 2 (a)	Classification of Governor.	[03]
Q - 2 (b)	A vibrating system is defined by the following parameters: Mass m = 3kg, Spring Stiffness k = 100 N/m, Damping Coefficient c = 3 N sec/m. Determine (i) Damping factor (ii) Natural frequency of damped vibration (iii) Logarithmic decrement (iv) Ratio of two consecutive amplitudes (v) Number of cycles after which the original amplitude is reduced to 20%.	[07]
Q - 3 (a)	Explain the terms 'under-damping', 'over-damping' and 'critical damping'	[03]
Q - 3 (b)	An Aeroplan makes a complete half circle of 50 mtr. radius towards left when flying at 200 km/Hr. the rotary engine and propeller of the plane has a mass of 400 kg and radios of gyration 0.3mm. the engine rotates 2400 rpm clockwise when viewed from the rear. Find the gyroscopic couple on air craft and also state it effects.	[07]

OR

Q - 3 (a)	Explain porter Governor.	[03]
Q - 3 (b)	A pump is supported on a spring and a damper. The spring stiffness is 6000N/m and the damper offers resistance of 480N at 3.5 m/s. The unbalanced mass of 0.6kg rotates at 40 mm radius and total mass of the system is 80 Kg. The pump is running at 500 rpm. Determine: i) damping factor, ii) amplitude of vibration iii) resonant speed and amplitude at resonance.	[07]
Q - 4	Attempt anyone.	[05]
(i)	Explain in brief Whirling of shaft	
(ii)	Explain gyroscopic effect on naval ship.	

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