D1903

Final Scheme/Answer Key for Valuation

Scheme of evaluation(marks in brackets) and answers of problems/key

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: BE 100

Course Name: ENGINEERING MECHANICS

Max. Marks: 100 | Duration: 3 Hours

PART A (ANSWER ALL QUESTIONS: 8 X 5 = 40 MARKS)

1		Statement (2) Proof (3)	(5)
2		Equation $\cos^2\Theta_x + \cos^2\Theta_y + \cos^2\Theta_z = 1$ (1) $\Theta_x = 118.9^o$ (1) Fy= 78.6kN (1) Fz= 142.44kN (1) F= 185.92 kN (1)	(5)
3		FBD (1) Limiting friction= 108N (2) Coefficient of friction = 0.72 (2)	(5)
4		Rad. of gyration (2) Product of inertia (1.5) Polar moment of inertia(1.5)	(5)
5		Concept of Instantaneous centre (2) Method of location (2) Figure (1)	(5)
6		Free vibration (2.5) Forced vibration (2.5)	(5)
7		D'Alemberts principle (2) FBD (1) Equation (2)	(5)
8		Eqn(2) M =12.7 kg (2) Weight = 124.27N (1)	(5)

PART B

SET 1

(ANSWER ANY 2 QUESTIONS : 2 X 10 = 20 MARKS

9	a)	Distinguish force and couple (2) Characteristics of couple of forces at least three (3)	(5)
	b)	FBD (1) 3 equilibrium equations (2) R_A=10.84 kN angle with vertical 88.25^0 (1.5) R_B=1.84 kN (0.5)	(5)

10		Unit vector along AB = $-7i + 3j - 5k$ (2) Force vector = $\frac{P}{\sqrt{83}}(-7i + 3j - 5k)$ (1) Moment vector = $\frac{P}{\sqrt{83}}(-17i - 8j + 19k)$ (2) P = 911 N (1) M_x = -1700 N (2) M_y = -800 N (2)	(10)
11		3 equations of equilibrium (formula with substitution) (3) ΣF_x = -80 N (1.5) ΣF_y = -238.56 N (1.5) Resultant =251.6 N (1) Angle with horizontal =$71^0 27'$ (1) Perpendicular distance of line of action of R with respect to A= 5.96m or Hor.distance of the resultant w r to A=6.13m (1) ***Marks may be given to students if they have fixed position wrto any other point, if found correct.*** Resultant shown in figure (1)	(10)
SET II (ANSWER ANY 2 QUESTIONS : 2 X 10 = 20 MARKS			
12		Free body diagram of block and wedge (2+2) Equation formulation of block and wedge (2) Calculation of reactionsat contact surfaces($R_{1\&}$ R_2) (2) Reaction between block and Wedge B ,R_2 = 565.1 6N Reaction from support to wedge B = 488.73 N Force P= 410.27N (2)	(10)
13		X from left axis =5 m (1) Y from bottom axis= 4.26m(3) I_{XX}=275.71m^4(6)	(10)
14	a)	FBD (1) Equations of equilibrium (upward and downward motion (4) Least force = 364 N Greatest force = 839 N (1)	(6)
	b)	I_{XX}= 13824 mm^4 (1) I_{YY}= 55296 mm^4 (1) I_{XY}=20736 mm^4 (1) I_{XX} at 30^0 to OX= 6234mm^4 (1)	(4)
SET III (ANSWER ANY 2 QUESTIONS : 2 X 10 = 20 MARKS			
15		Free body diagrams of bodies (2) Equations of equilibrium (3)	(10)

		Acceleration=3.504 m/s^2 (2.5) Time=1.068 s (2.5)	
16	a)	Frequency=8/60, so T= 1/f=7.5 s (1) $\omega = 2\pi/T = 0.838$ rad/s (2) When the particle is at a distance of 7 m from the centre of motion, $V_{7m} = 0.6\ v_{max}$ Velocity at any point, $v=\omega\sqrt{(r^2 - x^2)}$ (1) Amplitude, r= 0.0875 m (2) Velocity of the particle at 5 cm from centre, V_{5cm} = 6.02 cm/s (1) Maximum acceleration, $a_{max} = r\,\omega^2$=6.14 cm/s^2 = 0.061 m/s^2 (1) ** 75% of credit can be given, if the student takes 7cm, instead of 7m.* ***Full credit can be given if the student has identified the mismatch of data and made a statement that the data is deliberately taken as 7cm instead of 7m.*	(8)
16	b)	Explanation: stiffness of a spring	(2)
17	a)	Figure (1) Angular velocity of crank = 31.416 rad/s (1) Angle made by the connecting rod with horizontal ϕ = 6.89° (1) Angular velocity of the connecting rod AB, ω_{AB} = 6.57 rad/s (1) Velocity of piston = 2.28 m/s (1)	(5)
	b)	Equivalent spring stiffness, $k=\frac{1}{k_1}+\frac{1}{k_2}$ k=2.4 KN/m (1) Deflection of the spring,δ=W/k δ=0.204 m (1) Period of vibration, $T=2\pi(\delta/g)^{0.5}$ T=0.91 s (1) Angular velocity, ω= 6.9 rad/s Maximum velocity, $V_{max}=\omega r$ V_{max} = 0.276 m/s (1) Maximum acceleration, $a_{max}=\omega^2 r$ a_{max}= 1.9 m/s^2 (1)	(5)
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