CARMEL COLLEGE OF ARTS, SCIENCE & COMMERCE FOR WOMEN, NUVEM-GOA
SEMESTER END EXAMINATION, JANUARY 2022

Semester: *I*
Course name & Code: *Section 1: Mathematical Methods and Mechanics;*
Section 2: Electrical Circuit Theory ; & PYC 101

Total marks: *80* **Date:** */01/2022* **Duration:** *2 Hours* **Total No of pages: 05**

Instructions:

1) *Answer Section-1 and Section-2 on separate answer book.*
2) *All questions are compulsory, however internal choice is available.*
3) *Figures to the right indicate maximum marks to the question.*
4) *Symbols have their usual meanings unless otherwise stated.*
5) *Draw neat diagram wherever necessary.*
6) *Use of non-programmable calculator is permitted.*

Section -1

Q1. Answer **any FOUR** of the following questions. *(4 x 4 = 16)*

(A) If $A = \begin{pmatrix} 1 & 2 & 5 \\ 2 & 3 & 2 \\ 1 & 4 & -1 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 3 & 4 \\ 2 & 4 & 6 \\ -1 & 3 & 4 \end{pmatrix}$.

Find $A^T B^T$

(B) Given the vectors $A = 2\mathbf{i} + 2\mathbf{j} - \mathbf{k}$ and $= 3\mathbf{i} - \mathbf{j}$. Calculate **A . B and A x B**

(C) Show that $[cos(\theta) + i\, sin(\theta)]^n = [cos(n\theta) + i\, sin(n\theta)]$. What is the third root of unity?

(D) State and explain Newton's second law of motion. Hence deduce the relation $\bar{F} = m\bar{a}$, where the symbols have their usual meaning.

(E) State and prove the principle of conversation of linear momentum.

(F) A body is projected with a velocity of $40ms^{-1}$. After 2s it crosses a vertical pole of height 20.4 m. Find the angle of projection and horizontal range of projectile. (use $g=9.8m/s^2$)

(2 x 3 = 6)

Q2.(A)

(p) Evaluate the limit if possible or state that it does not exist.

$$\lim_{x \to 0} \frac{\sin x \cos x}{x}$$

(q) The pulley arrangements as shown in the figure are identical. The mass of the rope is negligible. In figure (a), the mass m is lifted up by attaching a mass (2m) to the other end of the rope. In figure (b), m is lifted up by pulling the other end of the rope with a constant downward force F=2mg. In which case, acceleration of m is more?

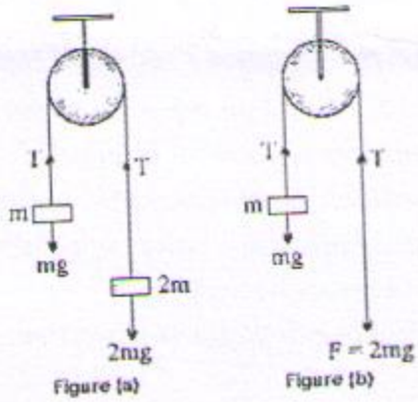


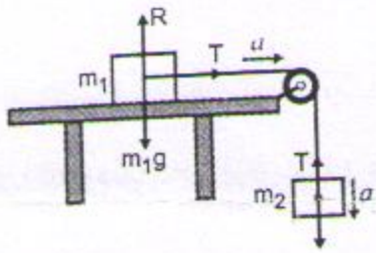
Figure (a) Figure (b)

OR

(2 x 3 = 6)

Q2.(A)

(x) A body m_1 of mass 10kg is placed on a smooth horizontal table. It is connected to a string which passes over a frictionless pulley and carries at the other end, a body m_2 of mass 5 kg (see figure below). What acceleration will be produced in the bodies when the nail fixed on the table is removed? What will be the tension in the string during the motion of the bodies? What, when the body stops?



(y) Determine if the function $(z) = \frac{5z-20}{z^2-12z}$ is continuous or discontinuous at z=0

(1 x 6 = 6)

Q2.(B)

Derive an expression for velocity of the particle in motion under a resistive force.

(2 x 3 = 6)

Q3.(A)

(p) Using chain rule evaluate $\mathbf{y = \sin^2(t)}$

(q) Evaluate $\int x\, e^{-x} dx$

OR

Q3.(A)

(x) Evaluate $\int \sqrt{1-x^2}\ dx$

(y) *Calculate the derivative of*

$$g(z) = \left(\frac{z^2-4}{z-1}\right)\left(\frac{z^2-1}{z+2}\right)$$

Q3.(B) *(1x6=6)*

Find (a) time of flight, (b) Max. Height (c) Horizontal range of projectile projected with speed 'v' making an angle θ with the horizontal direction from ground.

Section -2

Q1. Answer **any FIVE** of the following questions. *(2 x 5 = 10)*

(A) What is the efficiency of the circuit under maximum power transfer conditions?

(B) State Lenz's law of electromagnetic induction.

(C) What do you understand by the term time constant of a given RC or RL circuit?

(D) What is the reactance of a capacitor when a source of D.C. voltage is connected across it?

(E) What do you mean by 50 V, 500 mA transformer? Is it a step down or step up transformer?

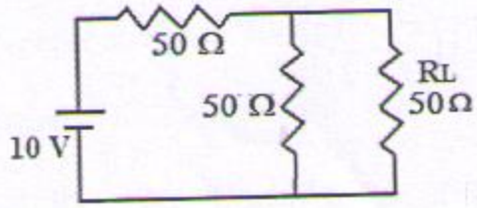
(F) Draw the circuit diagram of a general A.C. bridge and state its condition for its balance.

(G) What is the effect of change in frequency of an alternating supply on an inductive reactance and capacitive reactance?

Q2.(A)

(p) State the principle used in non-inductive resistance coils. *(2)*

(q) Find the current flowing through the load resistance R_L using Thevenins theorem *(3)*



OR

Q2.(A)

(x) Explain with necessary diagrams the concept of Ideal voltage source. *(2)*

(y) Two identical coupled coils have an equivalent inductance of 80 mH when connected in series aiding and 35 mH in series opposing. Find self-inductance of the two coils L_1, L_2. *(3)*

Q2.(B)

State and explain Norton's theorem of electrical network. *(5)*

Q3.(A)

(p) Explain why a spark appears when a high inductance circuit is suddenly opened *(2)*

(q) A d.c. source of emf 100 V is connected in series with a key, a capacitor of 2.0 μF and a resistor of 100 Ω. Find the maximum charge on the capacitor and the time taken for the charge to reach half its maximum value. *(3)*

OR

Q3.(A)

(x) Draw the frequency response curve for LCR series resonance. Give one application of a resonant circuit. *(2)*

(y) Obtain the relation for the R.M.S value of E.M.F. for an a.c. cycle? *(3)*

Q3.(B)

Obtain an expression for the decay of the current in a circuit consisting of an inductance, resistance and a D.C. source of e.m.f. V volts in series. *(5)*

Q4.(A)

(p) Why is series resonant circuit called an acceptor circuit, and parallel resonant circuit as a rejector circuit? *(2)*

(q) Calculate the maximum possible mutual inductance and turns ratio in a transformer if the inductance of primary coil is 25 mH and the inductance of secondary is 100mH. *(3)*

OR

Q4.(A)

(x) Draw the circuit diagram of a general a.c. bridge and state its condition for its balance. *(2)*

(y) In Wein's bridge R1 = 400 ohms, R2 = 800 ohms and C1= C2 = 1uf. Find the frequency at which the bridge balances. *(3)*

Q4.(B)

An alternating e.m.f. is applied to a circuit containing an inductor, capacitor and a resistor in series. Obtain an expression for the impedance and the current through the circuit.

(5)