TYBSc Physics 24/4/23

Time: 3 hrs. M. M.: 100

N.B.:

1. **All** questions are **compulsory**.
2. **Figures** to the **right** indicate **full** marks.
3. Draw **neat** diagrams wherever **necessary**.
4. Symbols have usual meaning unless otherwise stated.
5. Use of **non-programmable** calculator is allowed.

Q1. Attempt any two

(i) State and prove Kepler's laws of planetary motion. 10

(ii) Discuss quantitatively the motion of a particle in an inverse square field. 10

Show that the eccentricity of the particle is given by $\epsilon = \sqrt{1 + \frac{2EL^2}{mK^2}}$.

Give conditions on E and ϵ for different shapes of orbits.

(iii) What is a Foucault pendulum? Obtain equation of motion for it. Hence show that the pendulum precesses slowly clockwise in the northern hemisphere. 10

(iv) Consider a starred (rotating) reference frame rotating with angular velocity ω relative to the unstarred (fixed) frame with their origins O and O^* coinciding. Prove that for an arbitrary vector $\vec{A}$, 10

$$\frac{d^2\vec{A}}{dt^2} = \frac{d^{*2}\vec{A}}{dt^2} + \vec{\omega} \times (\vec{\omega} \times \vec{A}) + 2\vec{\omega} \times \frac{d^*\vec{A}}{dt} + \frac{d^*\vec{\omega}}{dt} \times \vec{A}$$

Q2 Attempt any two

(i) Starting with D'Alembert's Principle, obtain Lagrange's equations in terms of generalized coordinates. 10

(ii) What is meant by generalized co-ordinates? Derive an expression for generalized velocity and generalized kinetic energy. 10

(iii) A body of mass m_1 can move on a smooth flat horizontal table top. It is connected to a string of length ℓ which passes through a hole in the centre of the table. The other end of the string is connected to a mass m_2 which is suspended vertically. Identify appropriate generalized coordinate for the system and obtain the equations of motion using D'Alembert's principle. 10

(iv) A double pendulum consists of two weightless rods connected to each other and a point of support. The masses m_1 and m_2 are not equal but the length of the rods are equal. Pendulums are free to swing only in one vertical plane. Write down the Lagrangian for the system. 10

Q3 Attempt any two

(i) For a moving fluid show that 10

a) $\frac{dp}{dt} = \frac{\partial p}{\partial t} + \bar{v} \cdot \bar{\nabla} p$

b) $\frac{d}{dt}\,\delta V = \bar{\nabla} \cdot \bar{v}\,\delta V$

(Symbols have their usual meanings)

(ii) Derive Bernouilis theorem. Hence for a steady flow of the fluid show that, 10

$\frac{v^2}{2} + \frac{p}{\rho} - G + u = constant$ (Symbols have their usual meanings)

(iii) With reference to rotations of rigid body explain setting of the Euler's angles. Draw suitable diagrams. Find expression for the Lagrangian of a heavy symmetric top. 10

(iv) Derive an expression for the moment of inertia tensor for a rigid body made up of N number of particles. 10

Q4 Attempt any **two**

(i) Discuss numerical solutions of Duffing's equation for 10
$\gamma = 0.1$ *and* $f = 0.5$ and 2) $\gamma = 0.1$ *and* $f = 3$.
Compare the nature of odd and even harmonics.

(ii) Consider an anharmonic oscillator with potential energy 10
$V(x) = K\left(\frac{x^2}{2} + \frac{\alpha x^4}{4}\right)$ where K is the spring constant and α is anharmonic coefficient. Discuss the potential energy curve for positive and negative values of K and α. Comment on confinement of motion.

(iii) Discuss fixed points of a logistic map, stability of fixed points and periodic attractors. Discuss logistic map for $3< \lambda <4$ and explain the onset of chaos qualitatively. 10

(iv) Discuss numerical solutions of Duffing's equation for 10
1) $\gamma = 0.1$ *and* $f = 20$ and 2) $\gamma = 0.1$ *and* $f = 25$

Q5. Attempt any **four**

(i) If a body of mass 100 kg is moving with a velocity of 10m/s; estimate the maximum Coriolis force experienced by the body. 05

(ii) The eccentricity of a planet's orbit about sun is 0.4. Find the ratio of the lengths of the semi major to the semi minor axes of the orbit of the planet. 05

(iii) Write down the Lagrangian for a simple pendulum and hence find its equation of motion. 05

(iv) Define constraints. With good examples, explain holonamic and non-holonomic constraints. 05

(v) Consider a fluid flow given by $\vec{v} = cy\hat{\imath}$. Show that the fluid is incompressible and non-irrotational. 05

(vi) What is a rigid body? Discuss the different types of rigid bodies with reference to the symmetry present in the body. 05

(vii) Two very close initial values of x on logistic map are 0.40000 and 0.40002 respectively. With λ=4, after 20 iterations the values are 0.14561 and 0.00170 respectively. Calculate Lyapunov exponent. 05

(viii) Discuss the nature of phase space diagram for 1)undamped oscillator and 2)damped oscillator. 05

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Time: 3 hrs. **Marks : 100**

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3. **Draw neat diagrams wherever necessary.**
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5. **Use of non-programmable calculator is allowed.**

Q1.		Attempt any two	
	(i)	Explain various methods of biasing JFET in active region.	10
	(ii)	Explain the construction and working of an n-channel depletion mode MOSFET. Draw and discuss its drain and transfer characteristics.	10
	(iii)	Explain the use of SCR as a half wave rectifier and derive the expressions for its average output voltage and current.	10
	(iv)	Explain the construction and working of a UJT. Draw the V-I characteristics and explain it.	10
Q2		Attempt any two	
	(i)	Draw a circuit of an emitter coupled differential amplifier having double ended input and single ended output. Using AC analysis derive an expression for voltage gain and input impedance.	10
	(ii)	In a differential amplifier explain what is meant by common mode signal. Using ac analysis derive an expression for common mode gain.	10
	(iii)	With the help of a neat circuit diagram explain the working of an inverting Schmitt trigger using operational amplifier. Derive an expression for its feedback factor and hysteresis. Draw a neat circuit diagram of a non-inverting Schmitt trigger using operational amplifier.	10
	(iv)	Explain with the help of neat circuit diagram, the principle and working of Wien bridge oscillator using operational amplifier. State the expression for its frequency of oscillation.	
Q3		Attempt any two	
	(i)	Draw the circuit diagram of voltage controlled oscillator using IC 555. Discuss its working. Derive the expressions for output time period.	10
	(ii)	Draw the circuit diagram of astable multivibrator using transistors. Explain its working. Sketch the waveforms at both collectors and both base terminals.	10
	(iii)	What is a bistable multivibrator? Draw the circuit diagram of bistable multivibrator using transistors. Discuss its working. What is the relation between input and output frequency of a bistable multivibrator circuit?	10
	(iv)	Draw the diagram of voltage feedback regulator circuit. Explain its working. Derive the expression for power dissipation in pass transistor.	10

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Q4 Attempt any **two**

(i) Explain the working of a two – input Transistor Transistor Logic NOR gate. **10**

(ii) Explain CMOS characteristics in terms of Sinking, Floating Inputs and transfer characteristic. **10**

(iii) Explain Basic Pulse Code Modulation. Explain companding process used to overcome problems of distortion and noise in the transmission of audio signals. **10**

(iv) Explain benefits of digital communication. **10**

Q5. Attempt any **four**

(i) The data sheet of a JFET gives the following information: I_{DSS} = 3 mA, $V_{GS(off)}$ = -6 V and g_{mo} = 5000 µS. Determine the transconductance for V_{GS} = -4V and find drain current I_D at this point. **05**

(ii) An ac voltage $v = 240\sin 314t$ is applied to an SCR half wave rectifier. If SCR the forward breakdown voltage of 180 V, find the time, during which SCR remains off. **05**

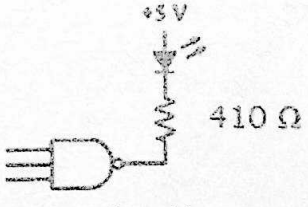
(iii) In a relaxation oscillator circuit using operational amplifier the timing components are R=4.7 kΩ and C = 0.1 µf. The feedback to non-inverting terminal is applied by a potential divider with R_1 = 5 kΩ and R_2 = 5 kΩ such that voltage across R_1 is the feedback voltage. Find the period of the output waveform. **05**

(iv) In an active one pole low pass filters using operational amplifier, R = 2.2 kΩ and C = 0.047µF. What is the cut-off frequency? **05**

(v) Calculate the time period of oscillation of an astable multivibrator using IC 555 if R_A = 1500Ω, R_B = 10KΩ, C = 0.47µF and V_{CC} = 12V. Also calculate frequency of oscillation and duty cycle. **05**

(vi) A voltage feedback regulator with fold back current limiting uses following components: R_4 = 100Ω, R_5= 4.7KΩ, R_6 = 10KΩ, V_{BE} = 0.7V and Vo = 7.2V. Calculate shorted load current and maximum load current. **05**

(vii) A TTL circuit drives an LED. When the TTL output is high, the LED is dark. When the TTL output is low, the LED lights up. If the LED voltage drop is 1.75 V, Calculate LED current for a low TTL output. **05**



(viii) The input voltage of a compander with a maximum voltage range of 1.2 V and a µ of 255 is 0.25V. What are the output voltage and gain? **05**

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4. Symbols have usual meaning unless otherwise stated.
5. Use of **non-programmable** calculator is allowed.

Constants: Planck's constant (h) = 6.64 x 10^{-34} J-s;
Mass of an electron (m_e) = 9.10 x 10^{-31} Kg = 0.00055 amu
Charge on electron (e) = 1.60 x 10^{-19} C
Speed of light (c) = 3 x 10^{8} m/s
1 eV = 1.60 x 10^{-19} J

Q1. Attempt any two

(i) (a) Explain how a magnetic spectrograph can be used to determine the velocity of alpha particles? 10
b) Write a short note on Geiger Nuttal law and discuss its significance.

(ii) Explain the origin of short range α-particles using the decay scheme. 10

(iii) What is Pauli's neutrino hypothesis? Also explain continuous β - particle spectrum. 10

(iv) Derive the energy conditions under which different types of beta decay can take place. 10

Q2 Attempt any two

(i) What is gamma decay? Explain the selection rules for gamma decay. Also discuss Gamma ray spectra. 10

(ii) Discuss Mossbauer effect with experimental setup. State the applications of Mossbauer effect. 10

(iii) From the Bohr-Wheeler theory obtain the stability limit against spontaneous fission. 10

(iv) Obtain Weizsacker's Semi-Empirical mass formula. Draw a neat diagram indicating the variation of contribution of different energy terms to the binding energy per nucleon with respect to mass number A. 10

Q3 Attempt any two

(i) Explain Nuclear Chain Reaction. What are the various factors on which it depends? 10

(ii) What is Nuclear Reactor? Explain its various features. 10

(iii) Describe the construction and working of Betatron. 10

(iv) Discuss in detail the principle, construction and working of Cyclotron. 10

Q4 Attempt any **two**

(i) Summarize the important experimental properties of the deuteron. **10**

(ii) State conservation laws for the various properties of elementary particles. **10**

Which of the following reactions can occur by conservation laws of elementary particles? If not, state the conservation principles violated by them.

a) $\Lambda^0 \rightarrow p + \pi^-$

b) $\pi^+ + p \rightarrow \pi^+ + p + \pi^- + \pi^0$

c) $\gamma + n \rightarrow p + \pi^-$

(iii) (a) Write note on electrons, positrons and their anti particles. **10**

(b) Explain Yukawa potential.

(iv) Explain qualitatively the Quark model. **10**

Q5. Attempt any **four**

(i) Ra^{226} decays by α – emission to Rn^{222}. The alpha disintegration energy is 4.863 MeV. Calculate the kinetic energy of the alpha particle. **05**

(ii) What is meant by electron capture? **05**

(iii) Explain the phenomenon of internal conversion. **05**

(iv) Write short note on shell model of nucleus. **05**

(v) Calculate the amount of energy available if 10gm of $_{92}U^{235}$ is completely fissioned. Given: Energy per fission = 200 MeV, and Avogadro's number = 6.022×10^{23} per gm-mole. **05**

(vi) Protons are accelerated in a 100cm cyclotron. The oscillator frequency is 10 Megacycle. Calculate the magnetic field needed for the protons. Also calculate the energy required for acceleration of ions. **05**

Given: e = 1.6×10^{-19} C, Mass of proton m = 1.67×10^{-27} kg.

(vii) On the basis of the meson theory, estimate the mass of the exchanged particle if the 'range' of the potential is 10^{-15} m? **05**

(viii) Show that lepton number and baryon number is conserved in case of neutron to (β^-) decay. **05**

RIZVI COLLEGE OF ARTS, SCIENCE AND COMMERCE
(University of Mumbai)

TYS 002 230427

T.Y.B.Sc. (PHYSICS) ELECTRONIC INSTRUMENTATION - II (USACE1602)
SEM - VI (03 Hours) Total Marks : 100
Time : 08·00 AM to 11·00 AM Date : 27 / 04 /2023

N.B. : (1) All questions are compulsory.
(2) Draw neat diagrams whenever necessary.
(3) Figures to the right indicate full marks.
(4) Use of log table or non-programmable calculator is permitted.

Q1 (A). Attempt any TWO (Each question carry 10 Mark) (20M)
(i) What do you mean by an encoder? Explain the functioning of IC 74148 priority encoder.
(ii) F(A,B,C,D) = Σm (0,2,3,4,7,9,10,12,14,15), Draw K-Map and find minimized Boolean expression along with circuit diagram.
(iii) With the help of truth table and K – maps, design binary to gray code converter.

Q2 (A). Attempt any TWO (Each question carry 10 Mark) (20M)
(i) Explain Subroutine with their CALL and RET instructions.
(ii) Explain the use of 8255A in simple Input or Output mode (0 Mode).
(iii) Write subroutine program for 8085, to find the square root of a number.

Q3 (A). Attempt any TWO (Each question carry 10 Mark) (20M)
(i) Explain the memory organization in 8051 Microcontroller (μ_c).
(ii) Write difference between Microprocessors and Microcontrollers (μ_c).
(iii) Define all four rotate instructions (RL, RLC, RR & RRC) with their example in (μ_c).

Q4 (A). Attempt any TWO (Each question carry 10 Mark) (20M)
(i) Write the structure of do-*while-loop* with one related program in C++ programming.
(ii) What is function in C++? What are the advantages of function prototypes in C++?
(iii) Write down the simple structure of C++ program and explain each and every special characters using in program.

Q5 (A). Attempt any FOUR (Each question carry 5 Mark) (20M)
(i) What are tri-state devices? Explain the tri-state switch.
(ii) Differentiate between PUSH and POP.
(iii) Describe the unidirectional buffer.
(iv) Differentiate between Harvard and Von Neumann architecture.
(v) Write down about memory management operator.
(vi) Spot the errors in the following C++ statement and write them correctly.
(a) #<iostream.h> (b) (M=1, M≥ 10, M++) (c) Cin >> a << b
(d) if (X > 35 and X ⩾ 50) (e) Cout >>Learning C++ is easy;

×_____END_____×