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M1N16089 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2016

PHY1C04 – Electronics

(2016 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Section A

Answer all questions (weightage 1 each)

1. Derive the small signal model of a typical FET device. Represent the equivalent network.
2. Give the operational principle of transferred electron devices with reference to their DNR property.
3. Explain how light is extracted from a LED. List the main factors which decide the extraction efficiency.
4. Give the principle of working of a LDR. Draw a circuit showing any application.
5. Define slew-rate of an OPAMP. Bring out its significance in circuit applications.
6. Sketch a circuit diagram representing a dual input, balanced output emitter coupled differential amplifier. Plot the output for a pair of identical sinusoidal input signals 180° out of phase.
7. Write the transfer function for a 2^{nd} order Butterworth high-pass filter. Sketch the filter response with corner frequency and gain roll-off marked.
8. What is an OPAMP Schmidt trigger? Mention any two applications.
9. Show the circuit symbol of a J-K flip-flop and explain the operation on the basis of its truth table. Mention the limitations of the device in circuit applications.
10. Compare synchronous and ripple counters.
11. Give a brief account of the working and application of CCD.
12. Describe briefly the significance of flag register inside microprocessor Intel 8085.

(12 x 1= 12)

Section B

Answer any two questions (weightage 6 each)

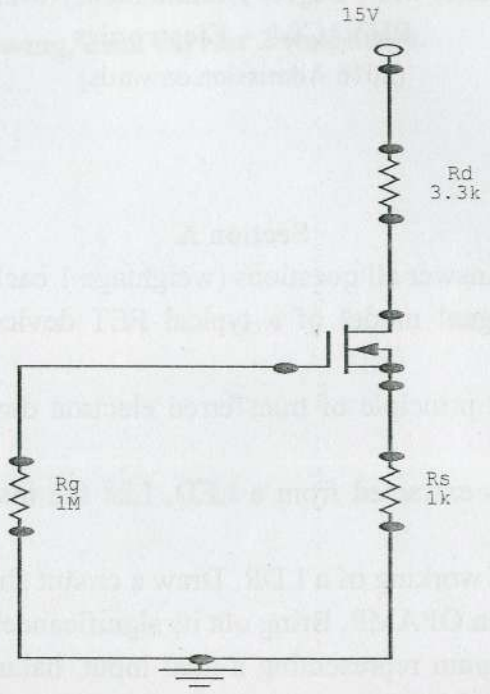
13. Discuss the low frequency common source FET amplifier. Derive expressions for voltage gain, input and output impedances.
14. Give a detailed account of the construction and working of a p-n junction solar cell.
15. Sketch a neat labeled OPAMP basic differentiator circuit. Show that the circuit can perform differentiation on a time dependent signal. Plot the output waveforms for sinusoidal, triangular and square inputs.
16. Sketch the circuit of a synchronous digital counter capable of counting up to six using minimum number of flip-flops and explain its operation. Construct the truth table and plot the timing diagram.

(2 x 6 = 12)

Section C

Answer any four questions (weightage 3 each)

17. Calculate trans-conductance of the FET device shown in the given circuit. I_{DSS} = 8mA, V_P = 4V.



18. A first order diffraction line is observed at 19.6° when a LED source is viewed through a plane transmission grating kept at normal incidence. If the grating has 6000 lines/cm, calculate the band gap of the LED material in eV.
19. An OPAMP has an open loop gain rated as 100db at 0 Hz. It is found that three poles exist in its transfer function at 500 KHz, 1 MHz and 4 MHz. Calculate the gain in db at 3 MHz.
20. Design a second order RC Butterworth filter with narrow band-pass characteristics using a single OPAMP employing multiple feedback, having a mid-band voltage gain equal to 40, center frequency at 200 Hz and 20 Hz bandwidth.
21. Using Karnaugh map technique design the simplest NAND gated circuit for realizing the following input output relations.
    Output is high when the decimal equivalents of the inputs are 2,5,7 and 8. Output is low for inputs 1, 3, 4, 9, 11, 12, 13, 14 and 15. Outputs are don't cares for the remaining inputs.
22. Show how a mod 8 counter is designed using one mod 2 and one mod 5 counter. Represent the truth table.

(4 x 3 = 12)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2016

PHY1C03 – Electrodynamics & Plasma Physics

(2016 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Section A

(Answer ALL, weightage 1 each)

1. Express Maxwell's equations in the integral form.
2. Comment on retarded potentials.
3. Express electric and magnetic fields in electrodynamics in terms of the scalar and vector potentials.
4. Distinguish between phase velocity and group velocity of waves.
5. Mention the three most common types of guiding structures that support TEM waves.
6. What is meant by plasma oscillations?
7. Why a Brewster's angle is also called a polarizing angle?
8. In what respects an ordinary electric network differs from a transmission line?
9. What are cavity resonators? Mention their applications.
10. What are four-vector potentials?
11. How will you explain magnetism as a relativistic phenomenon?
12. What is Debye shielding? Give the expression for the Debye length.

(12 x 1 = 12 weightage)

Section B

(Answer any TWO questions, weightage 6 each)

13. Define Poynting's vector. Deduce the Poynting's theorem for the flow of energy in an electromagnetic field.
14. Discuss the behavior of plane electromagnetic waves through an ionized medium and show that the cut-off frequency depends on the electron density.
15. Show that, when a finite transmission line is matched, the voltage and current distributions on the line are exactly the same as if the line has been extended to infinity.
16. Express Maxwell's equations in relativistically covariant form. Show that $\mathbf{E}^2 - \mathbf{B}^2 \mathbf{c}^2$ is a Lorentz invariant.

(2 x 6 = 12 weightage)

Section C

(Answer any FOUR questions, weightage 3 each)

17. Using the equation of continuity, show that the charge density inside a metallic conductor is $\rho(t) = \rho_0 \exp(-\sigma t / \varepsilon)$, where σ is the conductivity and ε is the permittivity of the material.
18. Show that for uniform plane electromagnetic waves in vacuum, the propagation vector, electric field vector and the magnetic induction vector are mutually orthogonal
19. Show that the skin depth in a good conductor is $\delta = 1/\sqrt{\pi f \mu \sigma}$, where the symbols have the usual meaning.
20. A rectangular waveguide with dimensions 1.067 cm and 0.432 cm operate in the dominant mode at 18GHz. Find the cut-off frequency and guide wavelength.
21. For a lossless transmission line, the capacitance per unit length is C and characteristic impedance Z_0. Find the velocity of electromagnetic waves in the line.
22. An electromagnetic wave is purely electric in an inertial frame S_1, that is $\mathbf{E} \neq \mathbf{0}$ and $\mathbf{B} = 0$. Obtain $\mathbf{B}$ in a frame S_2 that travels with a uniform velocity with respect to S_1.

(4 x 3 = 12 weightage)

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6087 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2016

PHY1C02 – Mathematical Physics

(2016 Admission onwards)

ime: 3 hours Max. Weightage : 36

PART A

Answer all questions , each has weightate 1

Prove that $\nabla.\nabla r^n = n(n+1)r^{n-2}$.

Prove that the determinant and trace of a matrix are invariant under similarity transformation.

Obtain the relation between unit vectors in cylindrical and Cartesian system

Define Contravariant and covariant tensors.

What are integral transforms? Give examples.

Show that Fourier series for an even function consists of cosine terms alone.

What do you mean by singular points? Check the singularities of Bessels equation.

How is Hermite polynomials related to quantum mechanical harmonic oscillator problem? Plot Harmonic oscillator wave functions.

Evaluate $\Gamma_{1/2}$

What do you mean by spherical harmonics?

Prove that Fourier transform of a Gaussian function is Gaussian.

Transform a non self adjoint equation to self adjoint form.

(12 x 1 = 12)

Section B

Answer any Two question, weightage 6

Derive expressions for gradient, divergence and curl in a general curvilinear system, and from that form expressions for curl, divergence and Laplacian in Cartesian and cylindrical coordinate system.

Discuss Gram -schmidt orthogonalisation procedure. Generate Legendre polynomial using this method.

Derive Fourier integral theorem. Obtain Fourier transform and inverse transform using this theorem.

Briefly explain Frobenius method to find series solution of ordinary differential equations.

Solve $y'' + \omega^2 y = 0$ using Frobenius method.

(2 x 6 = 12)

Section C

Answer any four questions each has weightage 3

Find the Fourier transform of a square pulse

$$f(x)=1 \text{ when } |x|<x_0 \text{ and zero } |x|>x_0$$

Find the eigen values and eigen vectors of the matrix

$$H=\begin{pmatrix} 0 & i \\ -i & 0 \end{pmatrix}$$

Verify whether the eigen vectors are mutually orthogonal.

Show that $\int_{-1}^{1} x p_n(x) p_{n-1}(x)dx = \frac{2n}{4n^2-1}$

Evaluate

a) $\int_0^{\pi/2} \sqrt{\tan\theta}\, d\theta$

b) $p_n(-x)=(-1)^n p_n(x)$

Show that $H_n(x)=(-1)^n e^{x^2}\left(\frac{d}{dx}\right)^n \exp(-x^2)$

(4 x 3 = 12)

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N16086 (Pages :1) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Degree Examination, November 2016

PHY1C01 – Classical Mechanics

(2016 Admission onwards)

Time: 3 hours Max. Weightage : 36

PART A

Answer all 12 questions. All questions carry *weightage 1*

1. Compare the Hamiltonian and Lagrangian formulations of Classical mechanics.
2. What are generalised coordinates? How are they more useful than Cartesian co-ordinates?
3. Explain the physical significance of Hamiltonian function.
4. Show that areal velocity is a constant if angular momentum is conserved.
5. State and explain the principle of least action.
6. Define Poisson Bracket of two dynamical variables.
7. Explain the term scattering cross section.
8. Which are the generalized coordinates needed to specify the motion of a rigid body.
9. Explain conditions for a sleeping top.
10. Show that the shortest distance between two points is a straight line.
11. What is Butterfly effect?
12. Give the characteristics of a Soliton.

(12 x 1 = 12)

PART B

Answer ant *two* questions. Each question carries a *weightage of 6*

13. Define scattering cross section. Derive an expression for differential scattering cross section in Rutherford scattering.
14. Discuss the motion of a rigid body in terms direction cosines and Euler Angles.
15. Solve the Kepler problem using Hamilton Jacobi method.
16. Obtain an expression for the normal frequencies and normal coordinates of the linear tri-atomic molecule vibrating freely.

(2 x 6 = 12)

PART C

Answer *any four*. Each carries a *weightage of three*

17. Write down the equation for a Van der Pohl oscillator and show how limit cycle is the attractor.
18. If $[\Psi, \Phi]$ is the Poisson Bracket of Ψ and Φ, find $\partial / \partial t\ [\Psi, \Phi]$.
19. Prove that kinetic energy and angular momentum are constants of motion for a rigid body rotating torque free.
20. For what values of m and n does the transformation $Q = q^n \cos np$ and $P = q^m \sin np$, become canonical?
21. Obtain the equation of motion of a spring constant K by Lagrange's method and obtain its period of oscillation.
22. Show that if angular momentum is a cyclic coordinate then the system has spherical symmetry.

(4 x 3 = 12)