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FACULTY OF SCIENCE

M.Sc. (I Semester) EXAMINATION.

Physics

MATHEMATICAL PHYSICS

Paper – I

(Under Choice Based Credit System)

Time : Three hours Maximum : 80 marks

Answer ALL questions.

All questions carry equal marks.

(5 × 16 = 80)

1. (a) Prove $n\,p_n(x) = (2n-1)x\,p_{n-1}(x) - (n-1)\,p_{n-2}(x)$.

(b) Show that $\frac{\gamma_n}{\gamma_{n-1}} = n-1$.

(c) Prove $L_n(x) = {}_1F_1(-n; 1; x)$.

(d) Find Laplace Transform form of $\sin at$.

2. (a) Derive solution for the Legender differential equation.

Or

(b) Prove the orthogonality conditions of Hermite polynomial.

3. (a) Show that $\gamma_m \gamma_n = \beta_{(m,n)}\,\gamma_{(m+n)}$

(b) Find the values of $\gamma_{\frac{1}{2}}$, γ_1 and γ_∞.

Or

(c) Solve the solution of differential equation $x\frac{d^2y}{dx^2} + (1-x)\frac{dy}{dx} + ny = 0$.

4. (a) Show Hypergeometric function $F = (\alpha, \beta, \gamma; x)$ in integral form $\frac{1}{\beta_{(\beta,\gamma-\beta)}}\int_0^1 (1-t)^{\gamma-\beta-1}t^{\beta-1}(1-xt)^{-\alpha}\,dt$.

(b) Find the second derivative of hyper geometric function ${}_2F_1(\alpha, \beta, \gamma; x)$ i.e., $\frac{d^2}{dx^2}\,{}_2F_1(\alpha, \beta, \gamma; x)$.

Or

(c) Solve the solution for confluent Hypergeometric function and show that ${}_1F_1(\alpha, \alpha; x) = e^x$.

[P.T.O.]

5. (a) Show that Fourier transform of a product of two functions is equal to convolution integral.

(b) Prove Fourier transform of a derivative of function $f(t)$ is in $g(w)$.

Or

(c) If $f(s)$ is the Laplace transform of $f(t)$, then show that Laplace transform of $F(at)$ is $\frac{1}{a} f\left(\frac{s}{a}\right)$.

(d) If $f(s)$ is the Laplace transform of $f(t)$, then show that Laplace transform of $\frac{df(t)}{dt} = sf(s) - f(0)$.

$L\{F(at)\} = \int_0^\infty e^{-st} F(at)\,dt$

$at = q$

$a\,dt = dq$

$dt = dq/a$

$= \int_0^\infty e^{-s\frac{q}{a}} F(q)\frac{dq}{a}$

$= \frac{1}{a}\int_0^\infty e^{-\left(\frac{s}{a}\right)q} F(q)\,dq$

$= \frac{1}{a} f(s/a)$

$L\{F(at)\} = \frac{1}{a} f(s/a)$

$L\left\{\frac{d}{dt}F(t)\right\} = \int_0^\infty e^{-st}\frac{d}{dt}F(t)\,dt$

$= \int_0^\infty e^{-st}\,dF(t)$

$= \left[e^{-st}F(t)\right]_0^\infty - \int_0^\infty F(t)\,(-s)e^{-st}\,dt$

$= -F(0) + s\int_0^\infty F(t)\,e^{-st}\,dt$

$= sF(s) - F(0)$

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FACULTY OF SCIENCE

M.Sc. (I Semester) EXAMINATION.

Physics

CLASSICAL MECHANICS

Paper — II

(Under CBCS)

Time : Three hours Maximum : 80 marks

Answer ALL questions.

All questions carry equal marks.

1. Answer the following:

   (a) Explain with an example how a constraint on the motion freezes one degree of freedom.

   (b) Define Poisson bracket and then show that $[q_i q_j]=0, [p_i, p_j]=0$ and $[q_i p_j]=\delta_{ij}$.

   (c) Obtain Euler's equations of motion for a rotating rigid body.

   (d) Explain the physical significance of Hamilton's characteristic function.

2. (a) State and explain D' Almebert's principle.

   (b) Derive Lagrange's equation of motion from D'Alembert's principle.

Or

   (c) Show that the Lagrangian is invariant under rotational motion.

   (d) Obtain the Lagrangian of a charged particle in an external electromagnetic field.

[P.T.O.]

3. (a) What is a canonical transformation?

(b) Show that the Poisson brackets are invariant under canonical transformation.

Or

(c) Obtain the Hamilton's canonical equations of motion from the principle of least action.

(d) Obtain Hamilton's canonical equations of motion in terms of spherical co–ordinates.

4. (a) What are the Eulerian angular co–ordinates?

(b) Show that Eulerian coordinates can be seen as three successive rotations which transform from fixed co–ordinate system to the moving co–ordinate system.

Or

(c) For the problem of a linear tri–atomic molecule obtain the relation between the generalized coordinates and the normal coordinates.

5. (a) Explain the method of solving a mechanical problem with hamilton–Jacobi method and use this method to obtain the solution of one dimensional harmonic oscillator problem.

Or

(b) Explain the importance of action–angle variables.

(c) Using action–angle variables determine the frequency of one dimensional harmonic oscillator.

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FACULTY OF SCIENCE

M.Sc. (I Semester) EXAMINATION.

Physics

Paper III — SOLID STATE PHYSICS

(Under CBCS)

Time : Three hours Maximum : 80 marks

Answer ALL questions.

All questions carry equal marks.

1. Answer the following :

   (a) Calculate atomic packing factor for hcp structure.

   (b) Explain group velocity and phase velocity of elastic waves.

   (c) What do you mean by effective mass of an electron? Explain.

   (d) What is the origin of ferromagnetic domains? Explain hysteresis.

2. (a) Define reciprocal lattice. Distinguish between Ewald sphere and limiting sphere. Discuss diffraction in reciprocal space.

Or

   (b) Discuss various types of nanostructures. How do you classify methods of preparation of nanomaterials?

3. (a) Discuss the propagation of elastic vibrations in a monoatomic linear lattice. How do you determine the dispersion relations?

Or

   (b) What are phonons? Discuss the theory of inelastic scattering of neutrons by phonons.

4. (a) What are the significant outcomes of Kronig – Penny model? Discuss with necessary mathematical theory.

Or

(b) Derive an expression for the concentration of electrons in an intrinsic semiconductor.

5. (a) What are the characteristics of a ferromagnetic material? How do you explain ferromagnetism in terms of the exchange integral?

Or

(b) Explain the Langeuin's theory of diamagnetism and derive an expression for the susceptibility.

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FACULTY OF SCIENCE

M.Sc. (I Semester) Examination

PHYSICS

Paper IV

(Electronic Devices and Circuits)

Time : 3 *Hours*] [*Max. Marks* : 80

Answer all *questions.*
All questions carry equal marks.

1. Answer the following:
   (a) Explain, how does BJT works as a switch?
   (b) Write a note on capcitor input filter.
   (c) Write a note on Darlington pair.
   (d) Describe the working of crystal oscillator.

2. (a) Explain the working and characteristics of solar cell with a neat diagram.
   (b) Describe the construction and V-I characteristics of FET.

   Or

   (c) Describe the construction of SCR and explain its working as controlled power rectifier.
   (d) Describe the construction and V-I characteristics of UJT with a neat circuit diagram.

3. (a) What is electronic filter? Explain the construction and working of LC filter.
   (b) Explain the working of Zener diode as voltage regulator.

   Or

   (c) What are the distinctions between linear and switching regulator.
   (d) Explain the working of LM78XX and LM79XX IC voltage regulators.

4. (a) Discuss the classification of feed back topologies.
   (b) Explain the characteristics and frequency response of emitter follower.

   Or

   (c) Write a note on classification of power amplifiers.
   (d) Explain the working of Class-A push-pull amplifier with a neat circuit and derive an expression for efficiency.

5. (a) Write a note on feed back concept and conditions for oscillations.
   (b) Explain the construction and working of 'Wein-Bridge oscillator with a neat circuit and derive the expression for frequency of oscillations.

   Or

   (c) Write a note on classification of multivibrators.
   (d) Describe the construction and working of actable multivibrator and deduce the expression for frequency of oscillations.

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FACULTY OF SCIENCE

M.Sc. (I Semester) Examination

PHYSICS

Paper IV

(Electronics Devices and Circuits)

(New)

Time : 3 Hours] *[Max. Marks : 80*

Answer all *questions.*
All questions carry equal marks.

1. Answer the following:
   (a) Explain the working of Laser diode.
   (b) Write a note on LM78XX series IC voltage regulators.
   (c) Explain the characteristics of emitter follower.
   (d) Write a note on crystal oscillator.

2. (a) Explain the construction and characteristic of photo diode.
   (b) Explain the working of transistor as a switch.

   Or

   (c) Explain the construction and characteristics of SCR.
   (d) Explain, how SCR works as a controlled power rectifier.

3. (a) What is load line and operating point of a transistor circuit?
   (b) Explain the stabilization in self-bias transistor circuit against variation of V_{BE} and β.

   Or

   (c) What are the distinctions between linear and switching regulators?
   (d) Explain the construction and working of switching mode power supply.

4. (a) Explain frequency response of RC-coupled CE amplifier with a neat diagram.
   (b) Write a note on Bode plot.

   Or

   (c) Discuss the classification of push-pull amplifiers.
   (d) Explain the construction and working of Class A push-pull amplifier with a neat circuit and mention its demerits.

[P.T.O.

5. (a) What is Barkhausen criterion?

(b) Explain the construction and working of RC phase-shift oscillator and derive the expression for frequency of oscillations.

Or

(c) What are the distinctions among astable, monostable and bistable multivibrators.

(d) Explain the construction and working of astable multivibrator with necessary diagram and deduce the expression for frequency of oscillation.

June 2019

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FACULTY OF SCIENCE

M.Sc. (I Semester) Examination

PHYSICS

Paper I

(Mathematical Physics)

Time : 3 Hours] *[Max. Marks : 80*

Answer all questions.
All questions carry equal marks

1 Write short notes on the following :

(a) Show that $H_n^1(x) = 2n\, H_{n-1}(x)$

(b) Show that $\beta(m,n) = \dfrac{\Gamma_m \Gamma_n}{\Gamma_{m+n}}$

(c) Show that ${}_2F_1(\alpha, \beta, \gamma; 1) = \dfrac{\Gamma\gamma\,\Gamma\gamma-\alpha-\beta}{\Gamma\gamma-\alpha\,\Gamma\gamma-\beta}$

(d) Find the Laplae transform of sin *h* (at).

2. (a) Use Frobenius method to solve the differential equation.

$$\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2ny = 0$$

Or

(b) Show that the condition for the orthogonality of Hermite polynomial is

$$\int e^{-x^2} H_n(x)\, H_m(x)\, dx = 2^n n!\sqrt{\pi}\,\delta_{mn}$$

(a) Show that $L_n(x) = \sum_{r=0}^{n} \dfrac{(-1)^r (n!)^2}{(r!)^2 (n-r)!}\, x^r$, where $L_n(x)$ is the Laguerre polynomial of degree *n*.

Or

(b) Prove that for Laguerre polynomial the orthogonality condition is

$$\int_0^\infty e^{-x} L_m(x)\, L_n(x)\, dx = \delta_{mn}$$

$$F(\alpha,\beta,\gamma;x) = \sum_{n=0} \frac{(\alpha)_n (\beta)_n x^n}{n!(\gamma)_n} = \int_0^1 \frac{t^{\beta-1}(1-t)^{\gamma-\beta-1}}{(1-xt)^{\alpha}}\, dt$$

Gauss

4. (a) (i) Show that $\frac{d}{dx} {}_1F_1(\alpha, \gamma, x) = \frac{\alpha}{\gamma} {}_1F_1(\alpha + 1, \gamma + 1; x)$.

(ii) $e^x = {}_1F_1(\alpha, \alpha; x)$.

Or

(b) Solve the confluent hypergeometric equation.

$$x \frac{d^2y}{dx^2} + (\gamma - x) \frac{dy}{dx} - \alpha y = 0.$$

5. (a) Prove that $F(t) = \frac{1}{2\pi i} \int_{c-i\infty}^{c+i\infty} f(s) e^{st} \, ds$ where $F(t)$ is inverse Laplace transform of $F(s)$.

Or

(b) State and prove convolution theorem for Fourier transforms.

(c) Find the Fourier transform of $e^{-a x}$.

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FACULTY OF SCIENCE

M.Sc. EXAMINATION

First Semester

Physics

MATHEMATICAL PHYSICS

Paper – I

Time : Three hours Maximum : 100 marks

Answer ALL questions.

All questions carry equal marks.

1. Write short notes on the following :

(a) Show that $2x H_n(x) = 2n H_{n-1}(x) - H_{n+1}(x)$.

(b) Define beta and gamma functions.

(c) Show that ${}_2F_1(\alpha, \beta, \gamma; 1) = \frac{\Gamma\gamma \, \Gamma\gamma - \alpha - \beta}{\Gamma\gamma - \alpha \, \Gamma\gamma - \beta}$

(d) Find Laplace transform of $\sinh(at)$.

2. (a) Solve Hermite differential equation

$$\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2ay = 0$$

where 'a' being a constant.

Or

(b) Find the indicial equation on the basis of Frobenius method.

3. (a) Prove that $x L_n'(x) = n L_n(x) - n L_{n-1}(x)$ where $L_n(x)$ is the Laguerre's polynomial of degree 'n'.

Or

(b) Write down the Laguerre's differential equation and find its polynomial solution.

P.T.O.

4. (a) On the basis of hypergeometric function show that the following statement is correct :

"... the series stops at p^{th} and q^{th} term respectively and again starts at $(p+q+1)^{th}$ term".

Or

(b) Solve the confluent hypergeometric equation

$$x\frac{d^2y}{dx^2}+(\gamma-x)\frac{dy}{dx}-\alpha y=0.$$

5. (a) What is meant by Fourier transform?

(b) Prove that the Fourier transform of the squared modulus of a function is given by self convolution integral.

Or

(c) Define Laplace transform.

If $\{F(t)\}=f(s)$, then prove that $L\{F'(t)\}=s\,f(s)-F(0)$.

(d) Find the Laplace transform of $\cosh(at)$.

(3428/11)

FACULTY OF SCIENCE

M.Sc. (I Semester) EXAMINATION

Physics

MATHEMATICAL PHYSICS

Paper — I

Time : Three hours Maximum : 80 marks

Answer ALL questions.

All questions carry equal marks.

1. Write short notes on the following :

(a) For Hermite polynomials show that

$$H_n(x) = (-1)^n e^{x^2} \frac{d^n}{dx^n} e^{-x^2}$$

(b) Define beta and gamma functions.

(c) Show that $\frac{d}{dx} F(\alpha, \gamma, x) = \frac{\alpha}{\gamma} F(\alpha+1, \gamma+1; x)$.

(d) State and prove convolution theorem for Fourier transforms.

2. (a) Find the solution of second order differential equation :

$$\frac{d^2y}{dx^2} + a_1 \frac{dy}{dx} + a_2 y = f(x).$$

Where a_1, a_2 are constants and $f(x)$ is a function of x.

Or

(b) Prove the orthogonality relation for Hermite polynomial

$$\int_{-\infty}^{\infty} e^{-x^2} H_m(x) H_n(x) dx = 2^n n! \sqrt{\pi} \cdot \delta_{mn}$$

[P.T.O.

3. (a) With the help of beta function evaluate $\int_0^1 \frac{dx}{\sqrt{1-x^n}}$.

(b) Obtain Rodrigues formula for Laguerre polynomials.

Or

(c) Obtain a series solution for Laguerre' differential equation.

4. (a) Solve the hypergeometric differential equation :

$$x(1-x)\frac{d^2y}{dx^2} + [\gamma-(\alpha+\beta+1)x]\frac{dy}{dx} - \alpha\beta y = 0 \text{ about } x=0.$$

Or

(b) Show that $P_n(\cos\theta) = (-1)^n_2 F_1\left(n+1, -n, 1; \cos^2\frac{\theta}{2}\right)$ where $2F_1$ is the hypergeometric function.

5. (a) Define Fourier transform and discuss its properties. State and prove Parseval's theorem.

Or

(b) Show that the transform of a product of two functions in given by a convolution integral.

(c) Find the Laplace transform of cosh (at).

FACULTY OF SCIENCE

M.Sc. (I-Semester) Examination

PHYSICS

(Classical Mechanics)

Paper—II

Time : Three Hours] [Maximum Marl

Note :— (1) Answer **ALL** questions.

(2) All questions carry equal marks.

1. Answer the following :—

(a) Distinguish between holonomic and non-holonomic constraints giving suitable exa

(b) Define Poisson Bracket. Evaluate the value of $[F, q_j]$ and $[F, p_j]$ where F is a function q_i's and p_i's.

(c) Find the principal axes and the principal moments of inertia for a thin rod of length

(d) Define Hamilton's characteristic function.

2. (a) Starting from Hamilton's variational principle, obtain the Lagrange's equation of mo

(b) Construct the Lagrangian and equation of motion of a spher al pendulum placed in a c gravitational field.

OR

(c) What is a cyclic coordinate ? What are the physical consequences if one of the coord ates in Lagrangian is cyclic ? Give examples.

(d) Derive the laws of conservation of energy and angular momentum from the space Time properties of the Lagrangian.

3. (a) What do you understand by Canonical Transformation ? Obtain the general transform tion equations for different types of generating functions

(b) Show that the transformation

$$Q_i = \alpha p_i,\ P_i = \beta q_i,\ \alpha \neq 0,\ \beta \neq 0$$ is canonical, and the transformed Hamilto

is $H' = -\alpha\beta H$.

OR

(c) Define Hamiltonian of a system and obtain the canonical equations of motion.

(d) Obtain the Hamiltonian and hence equation of motion of a charged particle in electromagnetic field.

4. (a) Derive an expression for kinetic energy of a rigid body and show that

$$T_{av} = \frac{1}{2}\overline{\Omega}.\overline{M}$$

and

$$\overline{M} = \underline{I}\,\overline{\Omega}$$

where $\underline{I}$ is the inertia tensor. Also show that

$$T_{av} = \frac{1}{2}\Sigma I_{ij}\Omega_i\Omega_j \qquad T = \frac{1}{2}I\omega^2$$

OR

(b) Construct Cayley-Klein parameters and obtain the relationship between these and Euler's angles.

5. (a) Discuss Operation and rotation with respect to a periodic system with one degree of freedom. Define Action-angle variables and outline the method of obtaining frequencies of the system.

(b) Obtain the frequency of one-dimensional harmonic oscillator by the method of Action angle variables.

OR

(c) Obtain the Hamilton-Jacobi equation for a mechanical system. How is it modified when the system is conservative?

(d) Apply Hamilton-Jacobi equation to obtain the solution of one-dimensional harmonic oscillator.

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FACULTY OF SCIENCE

M.Sc. EXAMINATION

First Semester

Physics

SOLID STATE PHYSICS

Paper — III

Time : Three hours Maximum : 100 marks

Answer ALL questions.

All questions carry equal marks.

1. (a) Calculate packing factors for bcc and hcp structures.

(b) Define group velocity and phase velocity.

(c) Discuss the concept of a 'hole' in semiconductors.

(d) Write a note on ferromagnetic domains and domain wall thickness.

2. (a) Explain diffraction of X-rays by a simple space lattice according to Von Laue and derive Laue equations.

(b) Discuss X-ray diffraction according to Bragg and derive Bragg's Law and show that the Laue equations and Bragg equation for X-ray diffraction are equivalent.

Or

(c) Discuss the seven basic crystal systems along with their characteristics.

(d) Discuss the [illegible] chloride structure, and cesium chloride [illegible] with the help of diagrams.

(e) Discuss the atomic packing in crystals with simple cubic structure by defining various terms involved.

3. (a) Discuss with necessary theory the vibrational modes of a diatomic linear lattice and explain the vibrations of particles in acoustical and optical branches. Explain the salient features of the dispersion curves.

Or

(b) Discuss the anharmonic effects on the energy associated with lattice vibrations.

(c) Discuss the thermal expansion of solids and calculate the coefficient of thermal expansion in terms of mean displacement of the atoms.

(d) Discuss phonon collission processer and explain what are Normal and Umklapp processes.

[P.T.O.]

4. (a) Discuss in detail the Kronig-Penny model for the motion of electron in a periodic potential and explain the conclusions that can be drawn.

Or

(b) Distinguish between intrinsic and extrinsic semiconductors.

(c) Derive an expression for the carrier concentration in an intrinsic semi conductor.

5. (a) Explain with necessary quantum theory the temperature dependence of magnetisation for paramagnetic materials and compare the theory with experiment for rare earth ions and iron group ions.

Or

(b) Discuss the concept of Heisenberg exchange interaction in the interpretation of the Weissfield and obtain Bloch $T^{\frac{3}{2}}$ law for temperature dependence of magnetisation.

7958/6

FACULTY OF SCIENCE

M.Sc. (I Semester) Examination

PHYSICS

Paper III

(Solid State Physics)

Time : 3 Hours] *[Max. Marks : 80*

Answer **all** *questions.*

All questions carry equal marks.

1. Write notes on the following :
   (a) Electron and neutron diffraction.
   (b) Infrared absorption by ionic crystals.
   (c) Constant energy surface and Brillouin zones.
   (d) Concept of magnons.

2. (a) Define Atomic Packing Factor (APF). Calculate APF for b.c.c and h.c.p structures.

   Or

   (b) Explain the concept of reciprocal lattice and its construction. What is Ewald Sphere and explain its significance?

3. (a) Discuss the case of lattice vibrations of monoatomic linear lattice. Apply the same to a finite lattice and discuss the vibrational modes.

   Or

   (b) What are phonons? Determine the dispersion relations experimentally using in elastic scattering of neutrons by phonons.

4. (a) Using Knowing penny model explain the formation of allowed and forbidden regions in E-K Curve and hence the energy bands.

   Or

   (b) As a consequence of K-P model explain the variation of velocity, acceleration and effective mass of the electron from bottom to top of the allowed energy band.

5. (a) What are the postulates of Weiss theory of ferromagnetism. Discuss in detail the characteristics behaviour of ferromagnetic materials.

   Or

   (b) Obtain an expression for the temperature dependance of spontaneous magnetisation.

FACULTY OF SCIENCE

M.Sc. (I-Semester) Examination

PHYSICS

(Electronic Devices and Circuits)

Paper—IV

Time : Three Hours] [Maximum Marks

Note :— (1) Answer ALL questions.

(2) All questions carry equal marks.

1. Answer the following :

(a) What is thermal stabilization ?

(b) Write a brief note on photodiode.

(c) Explain the function of emitter capacitance in an amplifier.

(d) Give the advantages of negative feedback in circuits.

2. (a) Explain transistor biasing and obtain the expression for stability factor under self bias

OR

(b) Give the analysis of common source FET amplifier regarding its frequency and gain response.

3. (a) What is full wave rectification ? Obtain an expression for efficiency in a full wave rectifier

OR

(b) Explain the construction of UJT and give detailed account of its characteristics

4. (a) Explain the gain-frequency response of a CE amplifier and obtain the expression for mid frequency gain.

OR

(b) Obtain the gain frequency response of an emitter follower and discuss its input and output impedances

5 (a) Explain the different types of feedback circuits and give the effect of negative feedback on an amplifier

OR

(b) Obtain the frequency expression for a Colpitt's oscillator and discuss the operation of a Colpitt's oscillator

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FACULTY OF SCIENCE

M.Sc. (I Semester) EXAMINATION.

Physics

ELECTRONIC DEVICES AND CIRCUITS

Paper — IV

Time : Three hours Maximum : 80 marks

Answer ALL questions.

All questions carry equal marks.

1. Answer the following :

(a) Explain biasing of a photo diode and sketch the characteristics.

(b) What is ripple factor and conversion efficiency of a rectifier? Explain.

(c) How do you classify amplifiers based on feedback topologies?

(d) What is Barkhau sen criteria? Give the classification of oscillators.

2. (a) Describe the FET construction. Explain its V-I characteristics. How FET is used as a Voltage variable Resistor (VVR)

Or

(b) Give the construction of SCR with its equivalent circuit using BJT symbols and Draw its V-I characteristics. Explain controlled power rectification.

3. (a) Describe briefly how LC and RC π type filters can be used with a rectifier circuit to reduce the ripple voltage with the help of necessary expression. What are variable IC voltage regulators?

Or

(b) Explain the Fuliwave rectifier circuit with a neat diagram and its working. Give a neat sketch of switch Mode Power supply (SMPS) and explain its action.

[P.T.O.]

4. (a) Give the analysis of an RC coupled amplifier at low, mid and high frequencies. Explain the concept of gain bandwidth product in the amplifier.

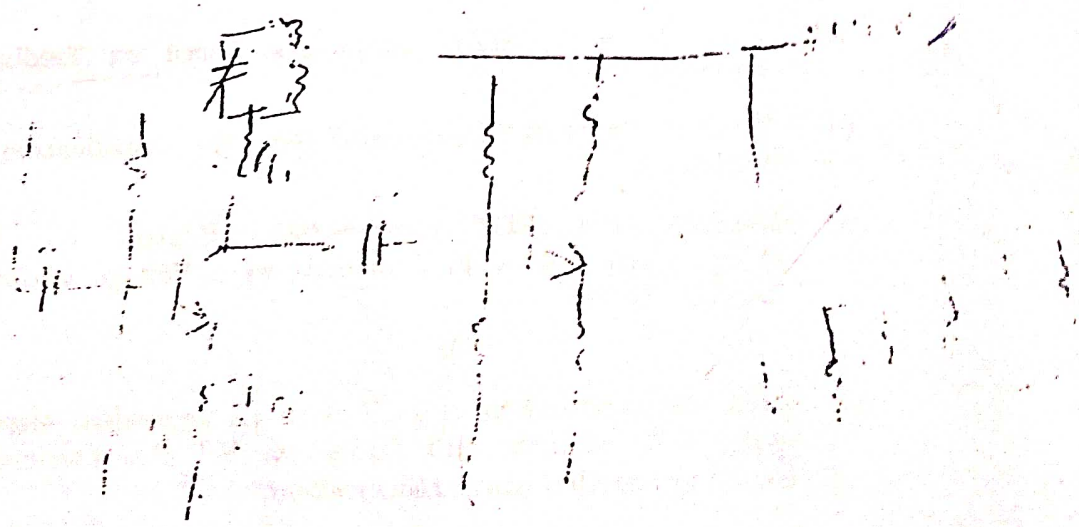
Or

(b) Draw the circuit diagram of a Class A push pull power amplifier and give the necessary analysis. What is the maximum efficiency that can be obtained with a transformer coupling? Mention the merits and demerits of class A operation in power amplifiers.

5. (a) Sketch the circuit of a phase shift oscillator and derive the expression for the frequency term in a phase shift oscillator. What is the range of frequencies for which this oscillator can be adopted? What are relaxation oscillators?

Or

(b) Sketch the neat circuit of an Hartley oscillator and obtain the expression for its frequency of oscillations. Give the circuit diagram of an astable multivibrator.



3429/10

FACULTY OF SCIENCE

M.Sc. (I Semester) Examination

PHYSICS

Paper II

(Classical Mechanics)

Time : 3 Hours] *[Max. Marks : 80*

Answer all questions.
All questions carry equal marks.

1 Answer the following:

(a) Explain the principle of virtual work.

(b) What is the physical significance of Hamiltonian?

(c) Write down the components of angular velocity in terms of Euler angles and their derivatives.

(d) Write a note on action-angle variables.

2 (a) Obtain the Lagrange's equation of motion from hamiltons variational principle.

(b) Obtain the Lagrange's equation of motion for a compound pendulum.

Or

(c) Explain how the Lagrange's equations of motion get modified in the presence of velocity dependent force.

(d) Setup the Lagrangian of a charged particle in the presence of external electromagnetic field.

3 (a) Obtain the Hamiltons equations of motion from the principle of least action.

(b) Obtain the hamiltons equations of motion for a free particle in spherical coordinates.

Or

(c) Explain what is a canonical transformation.

(d) Show that the transformation

$q = (2p)^{1/2} \sin Q$ and $p = (2p)^{1/2} \cos Q$

is a canonical transformation.

[P.T.O.

(a) What are the Cayley Klein parameters?

(b) Derive the relation between Cayley Klein parameters and Euler angles.

Or

(c) What are the Eulerian coordinates?

(d) Derive the expression for kinetic energy of a rigid body in terms of inertia tensor and angular velocity.

(a) Explain the procedure to obtain the solution of a mechanical problem with the Hamilton-Jacobi method.

(b) Apply Hamilton-Jacobi method to solve the problem of a simple pendulum.

Or

(c) Discuss the method of separation of variables in solving mechanical problem using Hamilton-Jacobi equation.

(d) Obtain the solution of Hamilton-Jacobi equation for 1D harmonic oscillator by using the method of separation of variables.

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FACULTY OF SCIENCE

M.Sc. (I Semester) EXAMINATION.

Physics

CLASSICAL MECHANICS

Paper — II

Time : Three hours

Maximum : 80 marks

Answer ALL questions.

All questions carry equal marks.

1. Answer the following:

(a) Show that the generalized momentum conjugate to a cyclic co-ordinate is a constant of motion.

(b) Show that if F and G are integrals of motion, then {F, G} is their Poisson bracket.

(c) Write down the components of angular velocity in terms of Euler angles and their derivatives.

(d) Write a note on Hamilton's characteristic function.

2. (a) Obtain the Lagrange's equation of motion from Hamilton's variational principle.

(b) Obtain the Lagrange's equation of motion for a simple pendulum

Or

(c) What is D'Albembert's principle and obtain Lagrange's equation of motion?

3. (a) What is the physical significance of the Hamiltonian?

(b) Obtain the canonical equations of motion of a charged particle in an external electromagnetic field.

Or

(a) Define canonical transformation.

(b) Show that Poisson Brackets are invariant under canonical transformation.

4. (a) What are the cayley-klein parameters?

(b) Derive the relation between cayley-klein parameters and Euler angles.

Or

(c) What are Eulerian angular co-ordinates?

(d) Derive an expression for the rotational kinetic energy of a rigid body.

5. (a) Obtain the Hamilton –Jacobi equation from Canonical transormation.

(b) Using Hamilton – Jacobi method solve the problem of a simple pendulum.

Or

(c) Explain what are the action – angle variables.

(d) Determine the frequency of one dimensional harmonic oscillator by the method of action-angle variables.

FACULTY OF SCIENCE.

M.Sc. EXAMINATION.

First Semester

Physics

CLASSICAL MECHANICS.

Paper — II

Time : Three hours Maximum : 100 marks

Answer ALL questions.

All questions carry equal marks.

1. Answer the following.

(a) Construct the Lagrangian and the equation of motion of a simple pendulum placed in a gravitational field.

(b) Determine the Hamiltonian of an anharmonic oscillator, if its Lagrangian is given by

$$L = \frac{1}{2}\dot{x}^2 - \frac{1}{2}\omega^2 x^2 - \alpha x^3 + \beta x \dot{x}^2.$$

(c) What are principal moments of inertia? State and prove the parallel-axis theorem.

(d) Define Action-Angle variables

2. (a) What are constraints of motion? Define generalised coordinates. Explain with examples.

(b) Construct the Lagrangian and obtain the equations of motion of a Coplanar double pendulum placed in a uniform gravitational field.

Or

(c) From D'Alembert's principle derive the equations of motion of an n-particle system. Show that, for a conservative system, these reduce to Lagrangian equations of motion.

3. (a) Determine the Hamiltonian of a free particle in Cartesian, cylindrical and spherical polar coordinates.

(b) Construct the Hamiltonian and obtain the equation of motion of a simple pendulum.

Or

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(c) What is Routhian? Describe Routh's procedure of obtaining equations of motion.

(d) A system has $T = \frac{1}{2}(\dot{q}_1^2 + \dot{q}_2^2/(a + bq_1^2))$ and $U = \frac{1}{2}(k_1 q_1^2 + k_2)$ where a, b, k_1 and k_2 are constants. Obtain equations of motion using Routh's procedure.

4. (a) Define Euler angles and show that these can be seen as three successive rotations which takes us from the fixed system to the moving axes system.

Or

(b) Derive Euler's equation for rigid body motion in a force field. Use these to obtain a complete solution of the problem of free rotation of a symmetrical top.

5. (a) Discuss the Hamilton-Jacobi theory of a mechanical system.

(b) Describe in detail the method of separation of variables in solving Hamilton-Jacobi equation.

Or

(c) Set up the Hamilton-Jacobi equation for Kepler's problem and outline the procedure of solving the same.

FACULTY OF SCIENCE

M.Sc. (I Semester) Examination

PHYSICS

Paper II

(Classical Mechanics)

Time : 3 *Hours*] [*Max. Marks* : 80

Answer **all** *questions.*

All questions carry equal marks.

1. Answer the following:
   (a) What is the advantage of Lagrangian formulation of mechanics over Newtonian formulation.
   (b) If two dynamical variables F and G are integrals of motion then show that their Poisson bracket is also a constant of motion.
   (c) Express the components of angular velocity in terms of Euler angles and their time derivatives.
   (d) Explain the importance of action-angle variables.

2. (a) What is D'Alembet's principle? Derive Lagranges equations of motion from this principle for conservative system.

   Or

   (b) Explain how the Lagranges equations of motion get modified in the presence of velocity dependent forces.
   (c) Set-up the Lagrangian for a charged particle in the presence of external electromagnetic field.

3. (a) Obtain the Hamilton's canonical equations of motion from the principle of least action.
   (b) Obtain the Hamiltons equations of motion for a compound pendulum.

   Or

   (c) Define Poisson bracket. What are the properties of Poisson brackets.
   (d) Show that Poisson brackets are invariant under canonical transformation.

4. (a) Define Euler's angles for the orientation of a rigid body and show that these can be seen as three successive rotations which take us from fixed axes system to the moving axes system.

   Or

   (b) Explain the precessional motion with and without mutation in the case of a spinning heavy symmetrical top.

5. (a) Explain the method of solving a mechanical problem with tile Hamilton Jacobi method and use this method to obtain the solution of a ID harmonic oscillator problem.

   Or

   (b) Set up Hamilton-Jacobi equation for Kepler's problem and obtain Kepler's third law of planetary motion.

FACULTY OF SCIENCE

M.Sc. (I-Semester) Examination

PHYSICS

(Solid State Physics)

Paper—III

Time : Three Hours] [Maximum Marks

Note :— (1) Answer ALL questions.

(2) All questions carry equal marks.

1. (a) Explain how neutron diffraction is advantageous over X-ray diffraction.

(b) Explain what is infrared absorption in ionic crystals.

(c) Explain quantitatively the effective mass of an electron.

(d) Discuss the principle of adiabatic demagnetisation.

2. (a) Define the terms :

(i) Lattice

(ii) Basis

(iii) Crystal structure

(iv) Unit cell

(v) Point group

(vi) Space group.

(b) What are symmetry elements ? Illustrate various symmetry elements present in a cub

(c) Show analytically that a five-fold rotation axis does not exist in a crystal lattice.

OR

(d) Explain the concept of reciprocal lattice and describe how the reciprocal lattice of a direct lattice can be constructed.

(e) Derive the relations between primitive translation vectors of direct lattice and recip lattice.

(b) Calculate the reciprocal lattices for sc, bcc and fcc lattices

3. (a) Derive an expression for the frequency of elastic waves in a mono atomic linear lattice on the basis of wave vector. Discuss the vibrational modes of a finite linear lattice and obtain the vibrational energy of the lattice at a temperature T.

OR

(b) Discuss the quantization of lattice vibrations.

(c) Describe how dispersion relations are determined experimentally by inelastic neutron scattering.

4. (a) Discuss the shapes of Brillouin zones for one and two dimensional lattices.

(b) Explain the motion of electrons in a one dimensional periodic potential with respect to

(i) Crystal momentum

(ii) Velocity

(iii) Degree of freedom of electron.

(c) Show from E-K graph that materials can be classified into conductors, semiconductors and insulators.

OR

(d) State and prove Bloch Theorem.

5. (a) Describe the Weiss molecular field theory of ferromagnetism and derive Curie-Weiss law.

(b) Discuss the temperature dependence of the spontaneous magnetisation in relation to this experiment.

OR

(c) Distinguish clearly diamagnetism, paramagnetism and ferromagnetism.

(d) Derive an expression for the diamagnetic susceptibility on the basis of classical ...

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FACULTY OF SCIENCE

M.Sc. (I Semester) Examination

PHYSICS

Paper III

(Solid State Physics)

Time : 3 Hours] *[Max. Marks : 80*

Answer all questions.

All questions carry equal marks.

1. Write notes on the following:
   (a) Carbon nanotubes.
   (b) Concept of phonon.
   (c) Constant energy surface and brillouin zone.
   (d) Quenching of orbital angular momentum.

2. (a) Distinguish between the Lane treatment and Bragg treatment of X-ray diffraction. Hence obtain Lane equations and Bragg relation and show that they are equivalent.

   Or

   (b) Discuss the diffraction in reciprocal space and obtain Bragg's law in vector form. Explain the diffraction with the help of Ewald sphere.

3. (a) Discuss the vibrational modes of a diatomic linear lattice and obtain expression for infrared absorption frequency.

   Or

   (b) What are phonons? Describe and explain experimental technique to determine dispersion relations using inelastic scattering of neutrons by phonons.

4. (a) State and prove Block theorem.

   Or

   (b) Using the conclusions drawn from Kronig penny model describe the motion of electrons in one dimension according to the band theory. Obtain the equation for effective mass and explain the factor f_K.

   (c) Distinguish between metals, insulators and intrinsic semiconductors.

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(a) Distinguish between the classical and quantum theory of paramagnetism. Discuss the temperature, variation of magnetisation and compare the theory and experiment for paramagnetic salts.

Or

(b) What is Weiss molecular field? Using quantum theory obtain Curie - Weiss Law, and discuss the temperature dependence of spontaneous magnetisation.

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FACULTY OF SCIENCE

M.Sc. (I Semester) Examination

PHYSICS

Paper II

(Classical Mechanics)

(New)

Time : 3 *Hours*] [*Max. Marks* : 80

Answer all questions.

All questions carry equal marks.

1. Answer the following :

   (a) What are constraints? Classify them with suitable examples.

   (b) Show that if F and G are integrals of motion, then so is their Poisson bracket.

   (c) Write down the components of angular velocity in terms of Euler angels and their time derivatives.

   (d) Write a note on action-angle variables.

2. (a) Derive Lagrange's equation of motion from the principle of least action.

   (b) Set-up the Lagrangian for a charged particle in an external electromagnetic field.

   Or

   (c) Show that the Lagrangian is invariant under rotational motion.

   (d) Find the Lagrange's equation of motion of the bob of a simple pendulum.

3. (a) Define Hamiltonian of a system and obtain canonical equations of motion.

   (b) Obtain Hamilton's canonical equations of motion in terms of spherical co-ordinates.

   Or

   (c) Define Poisson bracket and then show that

   $[q_i, q_j] = 0$, $[p_i, p_j] = 0$ and $[q_i, p_j] = \delta_{ij}$.

   (d) Show that the transformation $q = \sqrt{2P}\sin Q$, $p = \sqrt{2P}\cos Q$ is a canonical transformation.

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4. (a) For the problem of a linear tri-atomic molecule, obtain the relation between the generalized coordinates and the normal coordinates.

Or

(b) What are the Eulerian angular coordinates? (ϕ, θ, ψ)

(c) Derive the expression for kinetic energy of a rigid body in terms of inertia tensor and angular velocity.

5. (a) Explain stepwise procedure to find the solution of Hamilton-Jacobi equation.

(b) Apply Hamilton-Jacobi method to find the solution of one dimensional harmonic oscillator.

Or

(c) Set-up the Hamilton-Jacobi equation for Kepler's problem and obtain an expression for the time period of revolution.

FACULTY OF SCIENCE

M.Sc. (I Semester) Examination

PHYSICS

Paper II

(Classical Mechanics)

(New).

Time : 3 Hours] *[Max. Marks : 80*

Answer all questions.

All questions carry equal marks..

1. Answer the following:
   (a) What is a constrained motion and then show that a constraint on the motion freezes one degree of freedom.
   (b) Define Poisson bracket and then show that $[q_i, q_j] = 0$, $[p_i, p_j] = 0$ and $[q_i, p_j] = \delta_{ij}$.
   (c) What are normal coordinates and normal frequencies.
   (d) What is the physical significance of Hamilton's principle function.

2. (a) Derive Lagrange's equations from D'Alember's principle for a conservative system.
   (b) Explain how the Lagrange's equations, gets modified for a non-conservative system.

Or

   (c) Set-up the Lagrangian and obtain the Lagrange's equation for a simple pendulum.
   (d) Show that the momentum conjugate to a cyclic coordinate is constant in time.

3. (a) Obtain the Hamilton's canonical equations of motion from the principle of least action.
   (b) Obtain the Hamilton's canonical equations of motion for a charged particle in the presence of external electromagnetic field.

Or

   (c) Define Poisson bracket. List out the properties satisfied by the Poisson brackets.
   (d) For any three dynamical variables F,G and K prove that

$$[F, [G, K]] + [G, [K, F]] + [K, [F, G]] = 0.$$

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4. (a) Discuss the force-free motion of a symmetrical top and determine its precessional period.

Or

(b) What are the Eulerian angular coordinates?

(c) Obtain Euler's equations of motion for a rotating rigid body.

5. (a) Explain how the Hamilton-Jacobi equation can be solved by using the method of separation of variables.

(b) For a particle moving under potential $U(r, \theta, \phi) = a(r) + b(\theta)/r^2$, then obtain the solution of the Hamilton-Jacobi equation in the form of complete integral by using the method of separation of variables.

Or

(c) What are action-angle variables?

(d) Deduce the expression for the frequency of oscillations in case of one dimensional harmonic oscillator using action-angle variables.