MAJOR COURSE 1

PHY3CJ 201: Mechanics – I

FOUR-YEAR UNDER GRADUATE PROGRAMME (FYUGP)

BSc PHYSICS HONOURS

Programme	**B.Sc. Physics Honours**				
Course Title	**MECHANICS -I**				
Type of Course	**Core in Major**				
Semester	**III**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	PHY1CJ101: Fundamentals of Physics				
Course Summary	This course explores Newton's Laws of Motion and how they can be applied to solve different mechanical systems.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the concepts of linear and angular momentum, and dynamics of linear and rotational motion	U	C	Instructor-created exams / Quiz
CO2	Understand the concepts of the conservation laws of linear and angular momentum	U	C	Instructor-created exams / Quiz
CO3	Analyse collisions of particles using the conservation of linear momentum	An	P	Instructor-created exams / Home Assignments
CO4	Analyse rotating systems using the conservation of angular momentum	An	P	Instructor-created exams / Home Assignments
CO5	Demonstrate critical thinking and problem-solving skills by applying the concepts and techniques learned to solve an extended set of real-world problems.	Ap	P	Seminar Presentation / Group Tutorial Work
CO6	Demonstrate computational skills to solve an extended set of computational projects based on real-world problems	Ap	P	Seminar Presentation / Group Tutorial Work / Group Project
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F), Conceptual Knowledge (C), Procedural Knowledge (P), Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (48 +12)	Marks (70)
I		**MOMENTUM, IMPULSE AND COLLISIONS**	**11**	**16**
	1	Momentum and Impulse	2	
	2	Conservation of Momentum	2	
	3	Momentum Conservation and Collisions	2	
	4	Elastic Collisions	2	
	5	Centre of Mass	1	
	6	Rocket Propulsion	2	
	Sections 8.1 – 8.6 of chapter 8 of Book 1			
II		**ROTATION OF RIGID BODIES**	**12**	**18**
	7	Angular Velocity and Acceleration	2	
	8	Rotation with Constant Angular Acceleration	2	
	9	Relating Linear and Angular Kinematics	2	
	10	Energy in Rotational Motion	2	

	11	Parallel-Axis Theorem	1	
	12	Moment of Inertia Calculations	3	
	Sections 9.1 – 9.6 of chapter 9 of Book 1			
III	**DYNAMICS OF ROTATIONAL MOTION**		**12**	**18**
	13	Torque	1	
	14	Torque and Angular Acceleration for a Rigid Body	2	
	15	Rigid Body Rotation about a Moving Axis	3	
	16	Work and Power in Rotational Motion	1	
	17	Angular Momentum	2	
	18	Conservation of Angular Momentum	2	
	19	Gyroscopes and Precession	1	
	Sections 10.1 – 10.7 of chapter 10 of Book 1			
IV	**THE GRAVITATIONAL FIELD**		**13**	**18**
	19	Newton's Law of Universal Gravitation	2	
	20	The Gravitational Field and Field of an Extended Body	3	
	21	The Gravitational Potential	3	

	22	Field Lines and Equipotential Surfaces	1	
	23	The Newtonian Gravitational Field Equations	3	
	24	The Equations of Poisson and Laplace	1	
	Sections 9.1 – 9,7 of chapter 9 of Book 2			
V	**OPEN-ENDED MODULE: COMPUTATIONAL PROJECTS**		**12**	
	Manageable number of selected computational projects from the list given may be assigned and evaluated. Any other computational projects related to the content of the course may be chosen by the teacher.			
	1. Electrons are randomly distributed in a small region of space. (The dimension is not important, but you can assume a cube with side 10 angstroms.) Numerically determine the position of the center of mass, for 100, 1000, and 10000 electrons. (You should use a random number generator to obtain the coordinates of each of the electrons.)			
	2. A certain (imaginary) comet is in orbit about the Sun. It follows an elliptical path that is given by $r = 10/(1 + 0.8 \cos \theta)$, where r is measured in Astronomical Units (AU). Plot the orbit of the comet in polar coordinates.			
	3. A volcanic eruption throws a boulder vertically into the air with an initial speed of 50 m/s. (a) Write a computer program to plot the position and velocity of the boulder as a function of time, (b) Now assume the boulder is ejected at an angle of ten degrees to the vertical. Plot the two components of position and velocity as functions of time and also plot the trajectory of the boulder (on an x, y plot). Ignore the effect of air resistance.			
	4. A projectile is fired perpendicular to the Earth's surface with an initial velocity of 600 m/s. Assume a constant gravitational force acts on the projectile so its acceleration is 9.8 m/s^2 downwards. Write a program to determine the position of the particle as a function of time. Next, consider the same problem, but now include the effect of air resistance, assuming			

it is a retarding force that can be expressed as = 2.5 x $10^{-4}v^2$, where v is the velocity of the projectile.		
5. An asteroid of mass 5000 kg is at 40 AU from the Sun (beyond the orbit of Pluto) when it undergoes a collision with another asteroid, leaving it with zero velocity. The asteroid then slowly (at first) falls toward the Sun. Write a program to evaluate the velocity of the asteroid as it reaches the surface of the Sun. Use the Euler-Cromer algorithm. Check your result by comparing with the value obtained analytically. The purpose of this project is for you use variable time steps. Assume the radius of the Sun is 5.6 x 10^7 m. (1 AU = 1.5 x 10^{11} m).		
6. A 5 MeV alpha particle is approaching a gold nucleus. The impact parameter is 1 A^o. You may assume the gold nucleus is initially at rest. Plot the trajectory of the two particles and determine the angles at which both are scattered.		
7. You are required to design a two-stage rocket that will accelerate a 5000 kg payload to Earth's escape velocity. Assume that 95 percent of the mass of the rockets is fuel. Assume the exhaust velocity of the rocket motors is 2000 m/s. Investigate the possible ranges of masses for the two stages and determine the configuration that will minimize the take-off weight. Determine why a single-stage rocket, burning the same amount of fuel, cannot accomplish the same objective.		
8. Write a computer program to determine the position and velocity of a projectile fired vertically from the Earth's surface with an initial speed of 3000 m/s. Plot the position and velocity as a function of time. The Earth is assumed to be a sphere. You may neglect air resistance, the rotation of the Earth, and the effect of any other astronomical bodies, but note that the acceleration due to gravity varies with distance from the center of the Earth.		
● Computational Projects 1.1 – 1.4, 2.1 – 2.6, 3.1 – 3.3, 5.1 – 5.2, 6.1 – 6.6, 7.1, 9.1 – 9.4		
Sections from References: Computational Projects in chapters 1, 2, 3, 5, 6, 7, 9 of Book 2		

Books and References:

1. University Physics with Modern Physics (Edn.15) by Young & Freedman (Book 1)
2. Intermediate Dynamics (Edn.2) by Patrick Hamill (Book 2)
3. An Introduction to Mechanics by Daniel Kleppner and Robert J. Kolenkow
4. Mechanics by Keith R. Symon
5. Mechanics: Berkeley Physics Course, Volume 1 by Charles Kittel, Walter D. Knight and Malvin

   A. Ruderman
6. Mechanics: From Newton's Laws to Deterministic Chaos by Florian Scheck
7. NPTEL video lectures: https://nptel.ac.in/courses/115106090

Mapping of COs with PSOs and POs :

	PSO1	PSO 2	PSO 3	PS O4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	1	1	0	3	1	3	0	0	1	3	0	0
CO 2	3	1	1	0	3	1	3	0	0	1	3	0	0
CO 3	3	2	3	0	3	1	3	0	1	1	3	0	0
CO 4	3	2	3	0	3	1	3	0	1	1	3	0	0
CO 5	3	0	3	1	2	1	3	2	1	1	3	0	0
CO 6	3	3	1	2	2	2	3	0	1	2	3	0	0

MAJOR COURSE 2

PHY3CJ 202 : Computational Physics

FOUR-YEAR UNDER GRADUATE PROGRAMME (FYUGP)

BSc PHYSICS HONOURS

Programme	**B.Sc. Physics Honours**				
Course Title	**COMPUTATIONAL PHYSICS**				
Type of Course	**Core in Major**				
Semester	**III**				
Academic Level	**200-299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic computer knowledge.				
Course Summary	This course aims to equip students with computational and simulation methods in physics using Python programming. Numerical methods for differentiation, integration, solving differential equations, interpolation and curve fitting are introduced.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand computational thinking by learning Logical and algorithmic thinking.	U	F	Instructor created exams.
CO2	Understand python syntax and write basic python programs using loops, several data types etc	U, Ap	F, P	Instructor created exams / Practical Assignment

CO3	Understand Numpy and matplotlib modules and apply them to matrix manipulation and graphing data.	U, Ap	P	Instructor-created exams / Practical Assignment
CO4	Understand the significance of computational methods in physics.	U	F	Instructor-created exams / Seminar Presentation
CO5	Understanding the concepts of interpolation, curve fitting, numerical differentiation, integration and ODEs in physics using python	U, Ap	P	Instructor-created exams / Practical Assignment
CO6	Applying the computational and simulation methods to several branches of physics using python.	Ap	P	Instructor-created exams / Practical Assignment
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45 +30)	Marks (70)
I	**THE COMPUTATIONAL THINKING**		**6**	**10**
	1	Approach, Logical thinking, Algorithmic thinking	4	
	2	Writing algorithm - Sum of Two Numbers, Factorial Calculation, Bubble Sort, Fibonacci series up to a given term [More algorithms other than listed here can be given as assignments and can be asked for examination as application level questions].	2	
	Relevant Sections of Chapter 2 of Book 1			
II	**THE PROGRAMMING LANGUAGE : PYTHON**		**19**	**20**
	3	Print command, Data types in Python, Variables, Input statements, eval() and type casting, String operations.	1	
	4	Operators and Operator precedence, Expressions and Statements, Formatted printing,	2	
	5	List, Set, Tuple, Dictionary	2	
	6	Flow of Control : Sequential, Selective (simple if, if-else, nested	3	

		if, ladder if), Iterative (While, For), Continue, Break		
	7	File Input and Output, Pickling, User defined function. Built-in Functions.	2	
	8	Numpy : Arrays - creation, operations, eigenvalues solvers, dot, determinant, transpose, inverse, random number generation.	4	
	9	Matplotlib : Simple plot, Labelling axes, Title, Multiple plots, Subplots, Pie chart, Hist(), Polar plot, 3D plot - introduction	3	
	Relevant Sections of Book 2 and Book 3			
III	**COMPUTATIONAL TECHNIQUES FOR EXPERIMENTAL PHYSICS**		**10**	**20**
	10	Importance of Numerical Methods in experiments, Discretisation, Accuracy considerations.	1	
	11	Interpolation - Forward Difference Method - Newton's Formula for Interpolation.	2	
	12	Programs : Interpolation using experimental data*	1	
	13	Curve Fitting - Method of Least Squares : Linear, Linearization of Nonlinear Laws.	2	
	14	Programs : Curve fitting using experimental data*	1	
	15	Numerical Differentiation - 1st & 2nd order finite difference differentiation. Numerical Integration - Trapezoidal, Simpson's 1/3 Methods.	2	
	16	Root Finding Methods - Bisection, Newton-Raphson.	1	
	Sections : 3.1, 3.3.1, 3.6, 4.1, 4.2.1, 4.2.3, 6.2.3, 6.4.1, 6.4.2, 2.2, 2.5 of Book 4			
IV	**COMPUTATIONAL TECHNIQUES FOR THEORETICAL PHYSICS**		**10**	**20**
	17	Importance of Simulation in Physics. Solving First order ODE - Euler Method, Second Order Range-Kutta Method	2	
	18	Programs : Radioactive Decay*, Newton's Law of Cooling*	1	
	19	Solving 2nd Order ODE - Euler Method, Numerov's method	3	

	20	Programs : Configuration and Phase Space Plots of Simple and Damped Harmonic Oscillator*	2	
	21	Monte Carlo Method : Simple Integration - Hit or Miss Method, Mean-value Method (only)	1	
	22	Programs : Value of Pi*, Radioactive Decay*	1	
	Sections 8.4, 8.5 of Book 4 and 14.1, 14.2 of Book 5 [* Programs must be done using Python 3]			
V	**PRACTICALS**		**30**	
	Conduct any 6 experiments from the given list and 1 additional experiment, decided by the teacher-in-charge, related to the content of the course. The 7th experiment may also be selected from the given list. Other experiments listed here may be used as demonstrations of the concepts taught in the course.			
	1	**Solution of equations by bisection and Newton-Raphson methods** ● Implement the bisection method in Python from scratch. ● Provide at least 4 functions with a specific mathematical equation and find the root using their implementation. ● Analyze and explain the conditions under which the bisection method converges and discuss any potential pitfalls. ● Similarly, implement the Newton-Raphson method in Python. ● Provide the same or different functions and find the root using their implementation. ● Compare the convergence speed of the Newton-Raphson method with the bisection method for different functions.		
	2	**Least square fitting – straight line fitting** ● Write a code that fits a straight line to the data given and calculates the slope and intercept. ● Plots the regression line along with the data points by giving, labels, title, legends and different colors ● A real-world scenario or dataset can be used to apply linear regression to solve a practical problem.		
	3	**Numerical Integration – Trapezoidal and Simpson's 1/3 rd rule** ● Implement the Trapezoidal and Simpson's 1/3 Rule in Python for a function given. ● A physics scenario can be provided, where quantities like displacement, work, or energy are needed to calculate		

		through integration. Use both methods to perform the integration and interpret the results. ● Visualize the integration process by plotting the function and the areas under the curve corresponding to the Trapezoidal and Simpson's 1/3 Rule.		
	4	**Simulation of projectile using Euler Method** ● Implement projectile motion simulation using the Euler method in Python. ● Simulate the trajectory/ Plot using matplotlib (y vs x, y vs t and x vs t) ● Compare with the theoretical values of range, maximum height and time of flight. ● Change initial conditions such that the projectile is now a freely falling body. Plot y vs t. ● Extend the simulation to include air resistance and compare the projectile motion with and without air resistance.		
	5	**Simulation of simple and damped pendulums using RK2 Method** ● Simulates the damped pendulum and stores phase space coordinates to arrays using second order Runge-Kutta method. ● Provide initial conditions and damping parameters for the damped pendulum scenario. ● Plot the motion of the pendulum and phase space trajectories. ● Change the Initial conditions and damping factor and analyse the results. Make sure turning the damping off reproduces the simple pendulum result.		
	6	**Numerical differentiation using difference table.** ● Implement numerical differentiation using a difference table in Python. ● Provide a function y = f(x) and a set of data points. Compute the numerical derivative at specific points using the forward difference method. ● Discuss the sensitivity of numerical differentiation to the choice of step size. ● Present physics problems like compute the velocity or acceleration of a particle based on position data.		
	7	**Monte- Carlo simulation of radioactive decay**		

		• Implement a simulation of radioactive decay in Python. • Provide initial conditions (number of particles, decay constant) and analyze the results, including plotting the decay curve over time. • Calculate the half-life of the radioactive substance based on the simulation results and check how it compares to the theoretically expected half-life. • Provide information about a specific radioactive isotope with a known half-life to simulate the decay of this isotope and compare the simulation results with the expected decay.		
	8	**Estimation of value of pi using Monte-Carlo Simulation** • Implement a Monte Carlo simulation to estimate the value of pi in Python. • Analyze how the estimated value of pi converges as the number of samples increases. • Create visualizations of the simulation results. Plot the points used in the simulation and visually demonstrate how the estimation of pi improves as more points are sampled.		
	9	**Solution system of linear equations and calculation of eigenvalues** • Solve a system of linear equations with three variables. • Diagonalize a 3x3 matrix and verify that by evaluating the eigenvalues. Also evaluate the eigenvectors for the matrix. • For better understanding, use Python (interactive mode) to verify that the eigenvector for an eigenvalue satisfies the eigenvalue equation: matrix times eigenvector equals eigenvalue times eigenvector.		
	10	**Least square fitting to an exponential function** • Take the data of transient effect in RC circuit (growth / decay) and write a code that fits an exponential function to the data and calculates the time constant. • ExpEYES may be used to record the data. • https://expeyes.in/experiments/electrical/rctransient.html • https://expeyes.in/experiments/electrical/rltransient.html		
	11	**Taylor series- evaluation of sine and cosine** • Evaluate sine and cosine of a given angle, using Taylor expansion about zero. • Print the difference with the built-in sine function. • Analyse how the error reduces with the number of terms. • Modify the program to calculate for higher angles to observe the effect of accuracy.		

Books and References:
1. Computational Thinking by Karl Beecher (Book 1)
2. A Student's Guide to Python for Physical Modeling by Jesse M. Kinder, Philip Nelson. Second Edition-Princeton University Press 2021 (Book 2)
3. Python for Education by Dr. B P Ajithkumar, IUAC, New Delhi; e-book freely downloadable from https://scischool.in/python/index.html (Book 3)
4. Introductory Methods of Numerical Analysis by S.S. Sastry, Fifth Edition (Book 4)
5. Basic Concepts in Computational Physics by Benjamin A. Stickler and Ewald Schachinger, Springer International Publishing Switzerland 2014 (Book 5)

Mapping of COs with PSOs and POs :

	PSO1	PSO 2	PSO 3	PSO 4	PSO5	PSO6	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3	2	1	2	0	3	1	0	0	0	1	3	0
CO 2	0	3	2	0	0	3	0	3	0	0	0	3	0
CO 3	0	3	2	0	0	3	0	3	0	0	0	3	0
CO 4	0	2	3	0	0	3	0	3	0	0	0	3	0
CO 5	0	2	3	0	0	3	0	3	0	0	0	3	0
CO 6	0	3	3	0	0	3	0	2	1	2	3	0	0

Correlation Levels

Level	Correlation
0	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Discussion / Seminar
- Internal Theory / Practical Exam
- Assignments / Viva
- End Semester Exam (70%)

Mapping of COs to Assessment Rubrics

	Internal Theory / Practical Exam	Assignment / Viva	Practical Skill Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6		✓	✓	

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DEPARTMENT OF PHYSICS

CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA
(Affiliated to University of Calicut)

THIRD SEMESTER

B.Sc. PHYSICS HONOURS

(VALUE ADDED COURSES)

SYLLABUS

(FYUGP Regulations 2024)

VALUE ADDED COURSE - 1

PHY3FV108: Renewable Energy Sources

IMPORTANT: This course is for the Double Major pathway only.

Programme	**B.Sc. Physics Honours**				
Course Title	**RENEWABLE ENERGY SOURCES**				
Type of Course	**Value-Added Course 1**				
Semester	**III**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	0	45
Pre-requisites	Basic knowledge of different forms of energy				
Course Summary	This course provides a comprehensive introduction to various renewable energy resources with a focus on non-conventional sources Students will explore the principles, technologies, advantages, disadvantages, and practical applications of solar, wind, geothermal, ocean, and biomass energy.				

FOUR-YEAR UNDER GRADUATE PROGRAMME (FYUGP)

BSc PHYSICS HONOURS

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Develop a foundational understanding of energy resources, focusing on non-conventional sources such as solar energy, and grasp key terms and concepts including solar constant, radiation measurements, collectors, and practical applications of solar power	U	C	Instructor-created exams / Quiz
CO2	Discover wind energy comprehensively, covering utilization, advantages, disadvantages, environmental impact, sources, conversion principles, components, pros and cons, wind-electric power plants, economics, and operational challenges of large generators	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Gain insight into geothermal energy, exploring Earth's interior structure, geothermal systems like hot springs and various resources, and understanding the advantages, disadvantages, and applications of geothermal energy in comparison to other forms.	Ap	P	Seminar Presentation / Group Tutorial Work

CO4	Explore ocean energy, focusing on tidal and wave energy, understanding tidal power plant components, economic aspects, OTEC working principles, efficiency, types, and applications, considering advantages and disadvantages	U	C	Instructor-created exams / Home Assignments
CO5	Understand biomass with its resources and conversion processes, explore biogas applications and plants	Ap	P	Writing assignments
CO6	Study fuel cells, hydrogen energy, government schemes, and subsidies, and conduct plant visits for performance analysis.	Ap	P	Seminar Presentation /Viva Voce

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (36 +9)	Marks (50)
I		**Solar Energy**	**12**	**18**
	1	Introduction to Energy Resources-NonConventional Energy Sources-Renewable and Non-Renewable energy sources	2	
	2	Solar Energy Terms and Definitions: Solar radiation, Solar Constant	2	
	3	Measurement of Solar radiation, Solar energy collectors: Principle (Physical) of the conversion of solar energy into heat, Types of collectors,	3	
	4	Flat plate collector, Advantages, disadvantages and applications of flat plate collectors,Need of orientation in concentrating collectors, Advantages and disadvantages of concentrating collectors, Parabolic trough collector	3	
	5	Concentrating collectors (Performance analysis not needed) ,Solar air heaters and dryers,	1	
	6	solar cookers, Solar photovoltaic cells (no need of mathematical equations)	1	
	Sections 1.3, 1.4, 1.5, 2.2.1, 2.2.2, 2.3, 3.1.3, 3.2, 3.3.1 , 3.3.3, 3.4 - (excluding 3.4.11), 4.16, 4.17, 4.21.4 of Book 1			
II		**Wind Energy**	**7**	**10**
	7	Introduction, Utilisation aspects of wind energy, Advantages and Disadvantages of wind energy, Environmental impact of wind energy	1	

	8	Sources/Origins of wind, Principle of wind energy conversion and wind power, Pattern factor	2	
	9	Basic components of wind energy conversion system(WECS), Advantages and Disadvantages of WECS	2	
	10	Wind-Electric Generating Power Plant, Problems in operating large wind power generators	2	
	Sections 5.1-5.6, 5.8- 5.10, 5.11, 5.20, 5.26 of Book 1			
III	**Geo Thermal Energy**		**8**	**12**
	11	Introduction to Geothermal energy, Important aspects of Geothermal Energy, Structure of Earth's interior, Geothermal system-Hot Spring structure	2	
	12	Geothermal Resources -Hydrothermal, Geopressured	3	
	13	Geothermal Resources - Petro-thermal system, Magma Resources	2	
	14	Advantages and disadvantages of geothermal energy over other energy forms, application of geothermal energy	1	
	Sections 7.1, 7.2, 7.3, 7.5, 7.8.1, 7.8.2, 7.8.3, 7.8.4, 7.9, 7.10 of Book 1			
IV	**Energy from Ocean**		**9**	**10**
	15	Ocean Energy, Ocean Energy Sources, Tidal energy	2	

	16	Components of a Tidal Power Plant, Advantages and disadvantages of tidal power, Economic aspects of tidal energy conversion	2	
	17	Wave energy, Advantages and disadvantages, Factors affecting Wave energy	2	
	18	Ocean Thermal Energy Conversion (OTEC), Working principle of OTEC, Efficiency of OTEC	2	
	19	Types of OTEC Plants (Closed system, Thermoelectric OTEC system), Advantages and Disadvantages and Applications of OTEC	1	
		Sections 8.1, 8.2, 8.3.1, 8.3.8, 8.3.14, 8.4.1, 8.4.2, 8.4.3, 8.5.1, 8.5.3, 8.5.4, 8.5.5.1, 8.5.5.5, 8.5.6 of Book 1		
V	**Open Ended Module : Biomass and Chemical Energy**		**9**	
	1	Biomass resources, conversion process and applications		
	2	Biogas applications and biogas plants		
	3	Fuel cells and Hydrogen energy		
	4	Government schemes and subsidies for renewable energy projects		
	5	Any renewable energy plant visit and performance analysis		

Books and References:

1. Non- Conventional Energy Sources and Utilisation by R.K.Rajput, S.Chand Publishers, 1st Edition (Book 1)
2. Nonconventional energy resources by G D. Rai, Khanna publishers-2008 (Book 2)
3. Solar Energy by S B. Sukhatme-Tata McGraw-Hill Publishing Company Ltd - 1997 (Book 3)

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7
CO 1	2	2	2	1	0	0	0	0	0	0	0	0	0
CO 2	2	2	2	2	1	0	0	0	0	0	0	0	0
CO 3	2	2	2	2	1	0	0	0	0	0	0	0	0
CO 4	2	2	2	1	0	0	0	0	0	0	0	0	0
CO 5	2	2	2	1	0	0	0	0	0	0	0	0	0
CO 6	2	2	1	2	2	1	0	0	0	0	0	0	0

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

Quiz / Discussion / Seminar

InternalTheory/Practical Exam

Assignments /Viva

End Semester Exam (70%)

Mapping of COs to Assessment Rubrics

	Internal Theory /Practical Exam	Assignment /Viva	Practical Skill Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6		✓	✓	

CSC3CJ203- Software Project Management

Programme	B. Sc. Computer Science				
Course Code	CSC3CJ203				
Course Title	Software Project Management				
Type of Course	Major				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Computer Science knowledge 2. Understanding fundamental computer science concepts, data structures, and algorithms 3. Basic knowledge of project planning and scheduling				
Course Summary	Students are introduced to the concepts, procedures, and resources of software project management in this course. Project scheduling, budgeting, quality assurance, risk management, and teamwork are among the subjects covered. The goal of the course is to equip students with the skills necessary for efficient project management in software development settings.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define and explain the fundamental concepts, principles, terminologies and various models related to software project management.	Understand	C	Instructor-created exams / Quiz

CO2	Describe various design concepts and explain their roles in different phases of the project development life cycle	Understand	P	Assignments/ Test papers/ Viva Voce
CO3	Explain various Software Project Management (SPM) techniques and describe how project plans and schedules are developed using tools	Understand	P	Seminar Presentation / Group Tutorial Work/ Viva Voce
CO4	Understand the importance of quality in software development by mastering quality assurance processes,methodologies, testing strategies	Understand and	C	Instructor-created exams / Home Assignments
CO5	Prepare and deliver effective project presentations.	Create	P	Writing assignments/ Exams
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (48+12)	Marks (70)
I	Introduction to Software Engineering and Process Models		10	12
	1	Software and Software Engineering- nature of software, Software Engineering, Software Process	2	

	2	Software Development Life Cycle (SDLC)	2	
	3	Prescriptive Process Model- Water fall model, Incremental Model, Evolutionary Process Model	2	
	4	Agile Development- What is Agility, What is agile Process?	2	
	5	Extreme Programming	2	
II	Software requirements and Design Concepts		16	22
	6	Understanding requirements- requirement engineering process	3	
	7	Feasibility studies	1	
	8	Design Concepts- Design process, Design Concepts	2	
	9	Design Model Elements- Data design elements, Architectural design elements, Interface Design Elements, Component-Level Design Elements, Deployment-Level Design Elements	2	
	10	Architectural design using DFD	2	
	11	Component level design guidelines	2	
	12	Modelling with UML – Class diagram Use Case Diagram, State chart Diagram, Activity Diagram,	4	
III	Software Project Management		11	18
	13	Introduction to Software Project Management- Overview of software project management, Importance of software project management, Role of a project manager	2	
	14	Project Planning and Scope Management- Work breakdown structure (WBS) and project estimation techniques	2	
	15	Project Scheduling and Resource Allocation- Gantt charts and network diagrams,	2	
	16	Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT)	2	
	17	Risk Management-reactive vs proactive risk strategies, Risk identification, risk projection, RMMMM plan	3	
IV		Software Quality Assurance	11	18
	18	Quality Concepts- Software quality, Achieving Software quality,	2	
	19	Testing Strategies	2	
	20	Software testing- levels of software testing	1	

	21	Types of software test- Unit testing, Integration testing, Black box testing, white box testing, System testing	4	
	22	Art of debugging	2	
V	Open Ended Module- Trends in Software Engineering		12	
	1	▯ Case study of CASE tools ▯ Prepare a project report ▯ Analysis of real-world software project management case studies ▯ Group project presentations		

References

▯ Roger S, “Software Engineering – A Practitioner’s Approach”, seventh edition, Pressman, 2010.

▯ Pearson Education, “Software Engineering by Ian Sommerville”, 9th edition, 2010.

▯ Pankaj Jalote, An Integrated Approach to Software Engineering, 3rd Edition, Narosa Publishing House.

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- o Quiz / Assignment/ Quiz/ Discussion / Seminar
- o Midterm Exam
- o Programming Assignments (20%)
- o Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	End Semester Examinations
CO 1			
CO 2			
CO 3			
CO 4			
CO 5			
CO 6			

CSC3CJ204- Data Structures and Algorithm

Programme	B. Sc. Computer Science				
Course Code	CSC3CJ204				
Course Title	Data Structures and Algorithm				
Type of Course	Major/Minor				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Fundamental Mathematics Concepts: Set, Functions, Logic 2. CSC2CJ101 – Fundamentals of Programming				
Course Summary	This course explores implementations of linked list and array-based data structures, delving into the inner workings of basic data structures including lists, stacks, queues, trees, and graphs.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Differentiate basic data structures (arrays, linked lists, stacks, queues) based on their characteristics, operations and real-world applications,perform basic operations on Array and Linked list .	Understand	C	Instructor-created exams / Quiz
CO2	Performing basic operations and implementation of stack and queue datastructures using choosen programming language	Apply	P	Practical Assignment / Observation of Practical Skills
CO3	Identify the properties and applications of advanced data structures (trees and graphs).	Apply	P	Seminar Presentation / Group Tutorial Work
CO4	Investigate the properties of various searching and sorting techniques and hashing.	Understand	C	Practical Assignment / Seminar
CO5	Demonstrate critical thinking and problem solving skill by implement and analyse different data structure algorithms to address practical problems.	Apply	P	Viva Voce/ Observation of Practical Skills

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (45+30)	Marks (70)
I	0	Introduction to Data Structures and Basic Algorithms		15
	1	Overview of Data Structures: Data type Vs. Data structure, ADT, Definition of Data structure, Data structure Classification – Linear, Non- Linear (Array, Linked List, Stack, Queue, Tree, Graph)	1	
	2	Introduction to Arrays: Definition, Types (1 Dimensional, 2 Dimensional, Multi-Dimensional, Sparse matrix), Different Array Operations with Algorithm (insertion, deletion, traversal)	3	
	3	Structures and Self-referential structures	1	
	4	Introduction to Linked list: Definition, Types (Single linked list, Doublelinked list, Circular linked list- concept only).	2	
	5	Singly Linked List Operations with Algorithm (insertion, deletion, traversal)	2	
II		Stack and Queue	10	20
	6 7 8	Introduction to Stack: Definition, stack operations with Algorithm, Applications: recursion, infix to postfix - example and Algorithm	3	
		Implementation of Stack: using array (overflow & underflow) and Linkedlist (with algorithm)	2 2	
		Introduction to Queue: Definition, queue operations with Algorithm, Types: Double ended queue (Input Restricted and Output restricted), Circular queue, Applications		
	9 10	Implementation of Queue: using array and Linked list (with algorithm)		
II I		Non- Linear Data Structures		20
	11	Introduction to Trees: Basic terminology, Types (Binary tree- complete,full, skewed etc., Expression Tree)		
	12	Properties of Binary tree, Applications.		
	13	Binary tree representations- using array and linked list		
	14	Operations on Binary tree- Insertion, Deletion, Traversal-Inorder, preorder, postorder (concepts with examples)	2	
	15	Introduction to Graph: Definition, Basic terminology, Types (Directed, Undirected, Weighted).	2	
	16	Graph representation - Adjacency list and Adjacency Matrix, Applications.		
		Algorithm of non-recursive Binary tree traversal		
			2	
IV		Sorting and Searching	10	15
	17	Introduction to Sorting: Definition, Classification (Internal, External)	1	
	18	Internal Sorting Algorithms: Selection sort- Selection sort algorithm, Exchange sort- Bubble sort algorithm	2	
	19	External Sorting Algorithms: Merge sort- Demonstrate with example.(NoAlgorithm needed)	1	
	20	Advanced sorting Algorithm-: Quick sort- Demonstrate with example. (NoAlgorithm needed)	1	

	21 22	Introduction to Searching: Linear search and Binary search(Algorithm needed) with example.	2	
		Hashing: Hash Tables, Hash Functions, Different Hash Functions – Division method, Multiplication method, Mid square method, Folding Method, Collision and Collision resolution Techniques: Open hashing- Chaining, Closed hashing- Probing	2	
V	Hands-on Programming in Data Structures: Practical Applications, Case Study and Course Project		30 25	
	1	Implement the following: 1. Basic Operations in a single linked list (Menu driven) 2. Sort the elements in given singly linked list 3. Stack using array. 4. Stack using Linked list 5. Queue using Array 6. Queue using Linked list 7. Sorting algorithms- Selection, Bubble Sort 8. Searching Algorithms- Linear and Binary search		
	2	Project/ Case study	5	

REFERENCES

1. Seymour Lipschutz, “Data Structures with C”, McGraw Hill Education (Schaum's Outline Series)
2. Reema Thareja, “ Data Structures Using C”, Oxford University Press

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	InternalExam	Assignment	Practical Evaluation	End Semester Examinations
CO 1				
CO 2				
CO 3				
CO 4				
CO 5				
CO 6				

CSC3FM106- Digital Empowerment through Ethical Standards(MDC)

Programme	B. Sc. Computer Science				
Course Code	CSC3FM106				
Course Title	Digital Empowerment through Ethical Standards				
Type of Course	**MDC**				
Semester	II				
Academic Level	100 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	Basic understanding of computers				
Course Summary	This course explores the evolution from pre-digital challenges to the current digital landscape, covering historical milestones, key technologies, and the vision of Digital India. It emphasizes the benefits and importance of digital revolution while addressing ethical and security considerations. Participants engage with digital tools for personal and professional growth and examine case studies on digital infrastructure, missions, and services to understand real-world applications.				

Course Outcomes (CO):

CO	CO Statement		Knowledge Category#	Evaluation Tools used
CO1	Analyse the challenges of pre digital world and understand the importance of digitalization	Analyse	F	Instructor-created exams / Quiz
CO2	Identifying the applications of Cloud Computing, IoT, AI and Blockchain	Understand	C	Instructor-created exams/ Home Assignments
CO3	Understanding digital india initiatives	Understand	C	Instructor-created exams
CO4	Enhance the digital literacy by using ideration l tools for online data sharing, online learning, and content creation with awareness of ethical and security considerations in the digital age.	Apply	P	Instructor-created exams

CO5	Analyze the real-world case studies of digital infrastructure and digital technologies.	Analyse	C	Instructor-created exams

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs 36+9	Marks (50)
I		**Transition to Digital World**	**7**	**8**
	1	Challenges of Pre-Digital Age	1	
	2	Importance and Benefits of Digital Revolution	2	
	3	Key concepts: digitization, digitalization, digital transformation	1	
	4	Introduction to Key Digital Technologies: Cloud Computing, IoT, AI, Block Chain	3	
II		**Perspective of Digital India & Digital Innovations in Kerala**	**11**	**15**
	5	Understanding Digital India: Concept, Objectives, and Evolution	1	
	6	Overview of Digital Infrastructure: Broadband Connectivity, Digital Literacy, and Access to Information	2	
	7	Vision of Digital India: DigiLocker, E-Hospitals, e-Pathshala, BHIM, , e-Health Campaigns	3	
	8	Kerala-Emergence as Digital Society : Internet & Mobile Penetration in Kerala, 4 Pillars of Digital Emergence in Kerala (Akshaya Project, IT@School Project, Digital Infrastructure Availability, State Data Centre & allied Applications),	2	
	9	Role of K-DISC in Digital Empowerment	1	
	10	Kerala State IT Mission: Core IT Infrastructure, e-Governance Applications, Service Delivery Platforms,	2	
III		**Digital Tools for Personal and Professional Growth**	**9**	**12**
	11	Digital Tools for Data Sharing: Google Drive, Google Sheets	2	
	12	Digital Tools for Data Sharing: Google Docs, Google Classroom	3	

	13	Online learning platforms and resources (e.g., Coursera, Khan Academy, MOOCs, Duolingo)	2	
	14	Networking Tools: LinkedIn	1	
	15	Content Creation and Management: Canva	1	
IV	**Ethical and Security Considerations in the Digital Age**		**9**	**15**
	16	Understanding privacy in the digital age	1	
	17	Legal and ethical considerations in data collection and processing: Intellectual Property Rights (IPR)	2	
	18	Key Terminologies: Cyber Security, Cyber Crime, Cyber Attack, Cyber Espionage, Cyber Warfare	2	
	19	Authentication, Authorisation	1	
	20	Cyber Crimes and Classification	2	
	21	Introduction to Cyber Laws in India	1	
V	**Open Ended Module: Case Study (One from each set)**		**9**	
	1	Case Study on Digital Infrastructure Projects: (Bharat Broadband Network (BBNL) , Submarine Cable Project, Google Data Center)	3	
	2	Case Study on Digital Mission:	3	
		(Digital Literacy Missions in Kerala, SmartDubai Project, China's Digital Silk Road)		
	3	Case Study on Digital Services: (MyGov.in , Moodle LMS, Digital Payment Services)	3	

References

1. "Digital India Importance Needs and Values" by S K Kaushal
2. "Cyber Security in India: Government, Law Enforcement and Corporate Sector" by Vipin M. Chaturvedi and Shivani Kapoor
3. "Information Security: Principles and Practices in Indian Context" by R.S. Pressman, G. Sharma, and G. Sridhar
4. "Introduction to Computer Security" by Michael Goodrich and Roberto Tamassia
5. https://kdisc.kerala.gov.in/
6. https://itmission.kerala.gov.in/

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam

- Final Exam