Game Physics PHY1005

Course Code: PHY1005	**Course Title: Game Physics** **Type of Course:1] Open Elective** **2] Laboratory integrated**	**L- P- C**	2	2	3
Version No.	1.0				
Course Pre-requisites	**(Prior knowledge of physics and python programming is desirable but not mandatory). Knowledge of Python programming is desirable and basic knowledge of basic Physics concepts is desirable but not mandatory. Any familiarity with the topics will be useful for deeper application of concepts taught.**				
Anti-requisites	**NIL**				
Course Description	This course is a hands on experience of applying concepts in physics to a virtual environment. It demonstrates the important part of physics in computer based games and virtual reality environments. Many games like GTA (Grand Theft Auto), Oblivion, Half-Life, Crackdown, among others use principles of physics in real world to make the games more realistic. The course is both conceptual and analytical in nature while developing critical thinking and analytical skills. The course also enhances the programming abilities through assignments. The course will give an experience in modifying computer programs to obtain the desired results. The ability to think out of the box, confidence in facing new issues and self-learning will be encouraged through various assignments. Students will be using Python and IDLE/Jupyter installed in computer lab or on own laptops during this course.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of "Game Physics "and attain **EMPLOYABILITY SKILL** through **Experiential Learning** techniques				
Course Out Comes	On successful completion of the course the students shall be able to: 1] Identify various physics concepts applied in computer games and virtual reality environments. 2] Convert Physics concepts into mathematical language. 3] Model simplified real life physics phenomenon in a computer programing language 4] Collate parts of pre-written code to produce a working program which includes applied concepts of physics.				

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Course Content:				
Module 1	Kinetics and Kinematics	Assignment	Programming/Simulation	**No. of Classes: 8**
Topics: Fundamental topics in Newtonian mechanics such as center of mass, Newton's laws, inertia, linear and angular velocity and acceleration, momentum and general motion in two and three dimensions. Simulating the topics in mathematical and programing language.				
Module 2	Forces and Energy	Assignment	Programming/Simulation	**No. of Classes: 6**
Topics: Force and torque including drag forces, force fields, and pressure. Conservation of energy applied in collisions and projectile motion. Simulating the topics in mathematical and programing language.				
Module 3	Numerical Integrators and simple operations	Assignment	Programming/Simulation	**No. of Classes: 6**
Topics: Euler's method and Runge-kutta method of calculating integrals. Vector and matrix operations. Implementing the methods in programing language.				
Module 4	Particles and rigid bodies. Application of Python in Physics Simulation	Term paper	Programming/Simulation	**No. of Classes: 10**
Topics: Rigid body dynamics and simulation of particles, rigid bodies and connected rigid bodies. Programing a simple particle model, rigid body model and tuning with project. Use of Matplotlib for ploting, Aerofoil, pendulum motion, Pymunk concepts and applications.				
List of Laboratory Tasks: **Experiment No. 1: Test your coding skills** **Level 1: distribute 10 particles randomly on a chess board/square** **Level 2: make the particles a) look like circles b) move every two seconds** **Experiment No. 2: Center of mass and moment of inertia** **Level 1: Display the changing center of mass a when particles randomly move every two seconds**				

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Level 2: Display the changing moment of inertia around the center of mass every two seconds

Experiment No. 3: Velocity and acceleration
Level 1: show a particle moving towards a wall at a) constant velocity and b) with acceleration
Level 2: When it reaches the wall show that it returns with a) constant velocity b) with deceleration

Experiment No. 4: Projectile motion
Level 1: Plot the path of a projectile with and without gravity
Level 2: Show a moving projectile launched from different heights and different angles

Experiment No. 5: Algodoo project
Level 1: Use the Algodoo physics engine and software to display a car moving at constant velocity
Level 2: Create a upward and downward slope after the car travels for a short distance

Experiment No. 6: Explosion
Level 1: Create an explosion of kinematic particles
Level 2: When the particles reach the edge of the frame they bounce back

Experiment No. 7: Rotation motion
Level 1: Use the Algodoo physics engine to demonstrate rotational motion and moment of inertia
Level 2: Create a small game using Algodoo engine

Experiment No. 8: Understanding a program (simplest particle diffusion model)
Level 1: Write comments in the code explaining the logic
Level 2: Tune the code to make a) colour change with distance b) 2D instead of 3D.

Experiment No. 9: Understanding a program (N-body gravity model)
Level 1: Write comments in the code explaining the logic
Level 2: Tune the code to make a) create bodies with different size and mass

Experiment No. 10: Euler's method
Level 1: write a program to calculate result of a function using Euler's method
Level 2: write a program using modified Euler's method

Experiment No. 11: Runge-kutta (RK4) method
Level 1: write a program implementing Runge kutta (RK4) method
Level 2: calculate orbits in a gravity potential

Experiment No. 12: Matplotlib sample program
Level 1: Demonstrate the basics of Matplotlib for line graph, bar chart, scatter plot.
Level 2: Students modify data to display plots and change the appearance.

Experiment No. 13: Pymunk
Level 1: Installation and demonstration of Pymunk
Level 2: Complete simple program using Pymunk

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Targeted Application & Tools that can be used:
Python using Jupyter environment, Algodoo physics engine

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

Assessment Type

- Midterm exam
- Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource.)
- Quiz
- End Term Exam
- Self-Learning

Make a simulation of the solar system using Pygame.

Text Book

D.M. Bourg, B. Bywalec, 'Physics for Game Developers' O'Reilly Publications, 2nd Ed., 2013.

References

1. Jesse M. Kinder and Philip Nelson, 'A Student's Guide to Python for Physical Modeling', Princeton University Press, 2015.
2. University Physics Volumes 1 and 2 (OpenStax, 2016), https://openstax.org/details/books/university-physics-volume-1 https://openstax.org/details/books/university-physics-volume-2.
3. J.P. Mueller, Beginning Programming with Python for Dummies, Wiley Publications, 2017

E-resources:

1. https://presiuniv.knimbus.com/user#/searchresult?searchId=game%20physics&curPage=0&layout=list&sortFieldId=none&topresult=false
1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1587478&site=ehost-live
2. https://search.ebscohost.com/login.aspx?direct=true&db=iih&AN=60147826&site=ehost-live
3. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1587478&site=ehost-live

Topics relevant to "EMPLOYABILITY SKILL DEVELOPMENT": Application of Python in Physics Simulation and applying concepts of Physics in computer programs **for** Employability Skill Development through Experiential Learning Techniques. This is attained through the Assignment/ Presentation as mentioned in the assessment component in course handout.

Catalogue prepared by	Dr. Pradeep Bhaskar Dr. Deepthi P.R. Dr. Srinivas G

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Recommended by the Board of Studies on	7th BOS conducted on 25th July 2022
Date of Approval by the Academic Council	18th Academic Council Meeting held on 3/08/2022

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A-2[2021] COURSE HAND OUT [Integrated Course]

SCHOOL: Engineering **DEPT.:** Physics **DATE OF ISSUE: 12-Sep-2022**

NAME OF THE PROGRAM: B.Tech.

P.R.C. APPROVAL REF.: PU/AC-17/EEE/2021

SEMESTER/YEAR: II/2021-2022

COURSE TITLE & CODE: Game Physics PHY1005

COURSE CREDIT STRUCTURE: 2-2-3

CONTACT HOURS: 2 Hours Theory 2 hours Practical

COURSE INSTRUCTOR: Dr. Pradeep Bhaskar, Dr. Srinivas G, Dr. Deepthi P.R.

PROGRAM OUTCOMES:

Graduates of the B. Tech. Program in Computer Science and Engineering will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. (H)
PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. (M)
PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. (L)
PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. (H)
PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. (M)
PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. (M)
PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. (M)

COURSE PREREQUISITES:

NIL

COURSE DESCRIPTION:

This course is a hands on experience of applying concepts in physics to a virtual environment. It demonstrates the important part of physics in computer based games and virtual reality environments. Many games like GTA (Grand Theft Auto), Oblivion, Half-Life, Crackdown, among others use principles of physics in real world to make the games more realistic. The course is both conceptual and analytical in nature while developing critical thinking and analytical skills. The course also enhances the programming abilities through assignments.

The course will give an experience in modifying computer programs to obtain the desired results. The ability to think out of the box, confidence in facing new issues and self-learning will be encouraged through various assignments. Students will be using Python and IDLE/Jupyter installed in computer lab or on own laptops during this course.

Course Objective	The objective of the course is to familiarize the learners with the concepts of "Game Physics "and attain **EMPLOYABILITY SKILL** through **Experiential Learning** techniques

COURSE OUTCOMES:

On successful completion of the course the students shall be able to:

1] Identify various physics concepts applied in computer games and virtual reality environments.

2] Apply Physics concepts into mathematical language.

3] Compute simplified real life physics phenomenon in a computer programing language

4] Rewrite a working program which includes applied concepts of physics

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MAPPING OF C.O. WITH P.O.
[H-HIGH , M- MODERATE, L-LOW]

C.O. N0.	P.O.01	P.O.02	P.O.03	P.O.04	P.O.05	P.O.06	P.O.07	P.O.08	P.O.09	P.O.10	P.O.11	P.O.12
1									M	L		
2									M	L		L
3	M	M	L							L		
4	H				H					L		M

COURSE CONTENT (SYLLABUS):

Module: 1 **[8 Hrs] [Bloom's level selected: 1]**

Fundamental topics in Newtonian mechanics such as vectors, center of mass, Newton's laws, inertia, linear and angular velocity and acceleration, momentum and general motion in two and three dimensions. Simulating the topics in mathematical and programing language.

Module: 2 **[6 Hrs] [Bloom's level selected: 3]**

Force and torque including drag forces, force fields, and pressure. Conservation of energy applied in collisions and projectile motion. Oscillations in spring and pendulum. Simulating the topics in mathematical and programing language.

Module: 3 **[6 Hrs] [Bloom's level selected: 3]**

Euler's method and Runge-kutta methods of calculating integrals. Vector and matrix operations. Implementing the methods in programing language.

Module: 4 **[8 Hrs] [Bloom's level selected: 2]**

Application of Python in Physics Simulation. Use of Matplotlib for ploting, Aerofoil, pendulum motion, Pymunk concepts and applications.

SKILL SETS TO BE DEVELOPED:

1. **An attitude of enquiry.**
2. **Confidence and ability to tackle new problems.**
3. **Ability to interpret events and results.**
4. **Ability to work as a leader and as a member of a team.**
5. **Assess errors in systems/processes/programs/computations and eliminate them.**

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6. Observe and measure physical phenomena.
7. **Write reports.**
8. Select suitable equipment, instrument, materials & software
9. **Locate faults in system/Processes/software.**
10. Manipulative skills for setting and handling systems/Process/ Issues
11. The ability to follow standard /Legal procedures.
12. An awareness of the Professional Ethics.
13. Need to observe safety/General precautions.
14. **To judge magnitudes/Results/issues without actual measurement/actual contacts**

COURSE CONTENT &TASK SCHEDULE FOR LABORATORY COMPONENT:

Sl. No.	Session Number and Date	Task No	Task	Level 01	Level 2	Number of Lab Sessions required to complete the task	Skills to be developed	Course Outcome to be developed
01	1	1	Setup working program	Install python, pip	Run 'import pygame' without errors	1	1,2,5,7,9	4
02	2	2	Center of mass	Display the changing center of mass	Display the changing moment of inertia	1	1,2,5,7,9, 14	1,2,4
03	3	3	Velocity and acceleration	Particle in a) constant velocity b) acceleration	returns with a) constant velocity b) deceleration	1	1,2,5,7,9, 14	1,2,4
04	4	4	Projectile motion	projectile with and without gravity	projectile from different heights	1	1,2,5,7,9, 14	1,2,3
05	5	5	Algodoo project	Display a car moving	upward and downward slope for the car	1	1,2,3,4	1

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06	6	6	Explosion	explosion of particles	particles bounce back	1	1,2,3,4,5,7,9, 14	3,4
07	7	7	Rotation motion / Rigid Body	Simulate a rigid body triangle being thrown	Create option for user to select any sided regular polygon	1	1,2,3,4,7	1
08	8	8	Understanding a program with Algodoo example	comments in the code explaining the logic	Tune for colour change with distance	1	1,2,4,7	1,4
09	9	9	Understanding a complicated program	comments in the code explaining the logic	Tune for creating bodies with different size and mass	1	1,2,4,7	1,4
10	10	10	Euler's (modified) method	calculate result of a function using Euler's method	program implementing Euler's method	1	1,2,3,4,5,7,9	2,3,4
11	11	11	RK4 method	calculate result of a function using RK4 method	program implementing Runge kutta (RK4) method	1	1,2,3,4,5,7,9	2,3,4
11	11	11	Matplotlib sample program	Demonstrate the basics of Matplotlib for line graph, bar chart, scatter plot.	Students modify data to display plots and change the appearance .	1	1,2,5,7,9	4

DELIVERY PROCEDURE (PEDAGOGY):

The course is taught in an interactive manner with quizzes, tests, presentations, group work and assignments to gauge learning during the classes.

Self-Learning Topics: Numerical Methods

Non-Instructional Topics: Matrix Operations

Experiential Learning Topics: ALL

Technology Enabled Learning Topics: All

Problem Based Learning: All

REFERENCE MATERIALS:

Text Book:

D.M. Bourg, B. Bywalec, 'Physics for Game Developers' O'Reilly Publications, 2nd Ed., 2013.

Reference Materials:

1. Game Physics Notes
2. Jesse M. Kinder and Philip Nelson, 'A Student's Guide to Python for Physical Modeling', Princeton University Press, 2015.
3. University Physics Volumes 1 and 2 (OpenStax, 2016), https://openstax.org/details/books/university-physics-volume-1 https://openstax.org/details/books/university-physics-volume-2.
4. J.P. Mueller, Beginning Programming with Python for Dummies, Wiley Publications, 2017
5. Pygame Tutorials - Game Development With Python - techwithtim.net
6. Game Physics 2018/2019 (uu.nl) (http://www.cs.uu.nl/docs/vakken/mgp/2018-2019/)
7. Notes and ppts are available in the Teams folder ((6) General (Game Physics 2021-22 Sem 7) | Microsoft Teams)

GUIDELINES TO STUDENTS:

1. This is assisted learning. You need to do the learning and the faculty will only guide you.
2. It is necessary to spend time practicing and putting in interested effort.
3. The course focuses on helping you learn by yourself. You need to use the internet to get solutions and to develop further.
4. The dates and data mentioned in the CDCH may change hence use the latest updated CDCH uploaded in MS Teams class.

COURSE SCHEDULE FOR THEORY COMPONENT

Sl. No.	Activity	Starting Date	Concluding Date	Number of Sessions
01	Over View of the course	12-Sep-2022	12-Sep-2022	1
02	Module: 01	13-Sep-2022	7-Oct-2022	8
02	Module: 02	10-Oct-2022	02-Nov-2022	6

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03	Midterm	3-Nov-2022	12-Nov-2022	
04	Module: 03	14-Nov-2022	9-Dec-2022	6
05	Module: 04	12-Dec-2022	30-Dec-2022	8
	Last Instruction Day		31-Dec-2022	

Please note: Refer to the latest file updated in MS Teams class files for accurate data

COURSE SCHEDULE FOR LABORATORY COMPONENT:

Sl. No.	Activity	Starting Date	Concluding Date	Total Number of Periods
01	Overview, installation and Familiarization			2
02	Laboratory Task 1			2
03	Laboratory Task 2			2
04	Laboratory Task 3			2
05	Laboratory Task 4			2
06	Laboratory Task 5			2
07	Laboratory Task 6			2
08	Mid-Term			2
09	Laboratory Task 7			2
10	Laboratory Task 8			2
11	Laboratory Task 9			2
12	Laboratory Task 10			2
13	Review			2

SCHEDULE OF INSTRUCTION FOR THE THEORY COMPONENT:

Sl. no	Session no [date if possible]	Lesson Title	Topics	Course Outcome Number	Delivery Mode &Tools used	Reference
1	1	Registration, rules, requirements, Introduction PPT	Ice breakers, Applications, companies	1	Offline, Technology enabled	
2	2	Center of Mass	Calculate CoM in 1D	1, 2	Offline, Technology enabled	
3	3	Velocity, Acceleration	Equations, programs incorporating theory	1, 2	Offline, Technology enabled	

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4	4	Momentum	Examples, numerical, logic	1, 2	Offline, Technology enabled	
5	5	Force, force fields	Theory, applications	1, 2	Offline, Technology enabled	
6	6	Pressure, Torque	Theoretical calculation, program application, logic	1, 2	Offline, Technology enabled	
7	7	Energy conservation, projectile motion	Examples, formula, definition, logic	1, 2	Offline, Technology enabled	
8	8	Oscillations	Equations, application	1, 2	Offline, Technology enabled	
9	9	Collisions (with momentum and energy)	Examples, numerical, logic	1, 2	Offline, Technology enabled	
10	10	Review of previous topics	Application based	1,2		
11	11	Euler's method	Formula, program application, logic	1, 2, 3	Offline, Technology enabled	
12	12	Euler's method in code	Formula, program application, logic	1, 2, 3	Offline, Technology enabled	
13	13	RK 4 method	Examples, numericals	1, 2, 3	Offline, Technology enabled	
14	14	RK 4 method in code	Programs, logic	1, 2, 3	Offline, Technology enabled	
15		Midterm				
16	15	Review of Midterm Questions	Theory	1,2	Offline, Technology enabled	
17	16	Vectors and matrices	Examples, numerical, application	1, 2, 3	Offline, Technology enabled	
18	17	Vectors and matrices in code	numericals, applications	1, 2, 3	Offline, Technology enabled	
19	18	Assignment 1				

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20	**19**	**Particle behavior**	**Examples, logic**	**1, 2, 3, 4**	**Offline, Technology enabled**	
21	**20**	**Simulating particles**	**Examples, program**	**1, 2, 3, 4**	**Offline, Technology enabled**	
22	**21**	**Matplotlib**	**Examples, applications**	**1, 2, 3, 4**	**Offline, Technology enabled**	
23	**22**	**Aerofoil**	**Examples, applications**	**1, 2, 3, 4**	**Offline, Technology enabled**	
24	**23**	**Pendulum**	**Examples, logic**	**1, 2, 3, 4**	**Offline, Technology enabled**	
25	**24**	**Pymunk**	Dynamics introduction	**1, 2, 3, 4**	**Offline, Technology enabled**	
26	**25**	**Tuning of code**	**Examples, logic**	**1, 2, 3, 4**	**Offline, Technology enabled**	
27	**26**	**Demonstration of Algodoo**	**Plan a simulation**	**1**	**Offline, Technology enabled**	
28	**27**	**Assignment 2**	**Discussion**			
29	**28**	**Review**				

Topics relevant to "Employability Skill Development " : Application of Python in Physics Simulation and applying concepts of Physics in computer programs **for Employability skill through Experiential Learning techniques. This is attained through the assignment and lab experiments as mentioned in the assessment component.**

ASSESSMENT DETAILS:

Sl. No.	Assessment type	Contents	Course outcome Number	Duration (In Hours)	Marks	Weightage	Venue, Date & Time
1	**MidTerm**	**Module 1,2**	**CO 1,2**	**1.5**	**50**	**25%**	**09-May to 12-May 2022**
2	**Assignment Review of Digital e-resources from Pres. Univ. link given in the references Section-**	https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1587478&site=ehost-live	**CO 3,4**	**-**	**10**	**5%**	**15-Jun-2022**

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	(Mandatory to submit screenshot of accessing digital resource . otherwise it will not be evaluated						
3	Lab Exercises	Module 1,2,3,4	CO 1,2,3,4		40	20%	Weekly
4	End Term Lab Exam	Module 1,2,3,4	CO 1,2,3,4	3	100	50%	27-Jun to 9-Jul 2021

Assessment Matrix for Daily Task Evaluation for Laboratory component:

Sl. No.	Task No.	Marks for activity 01 [4]	Marks for activity 02 [3]	Marks for activity 03 [3]	Total Marks
1	Lab Task 1	Complete L1	Complete L2 with errors	Complete L2	10
2	Lab Task 2	Complete L1	Complete L2 with errors	Complete L2	10
3	Lab Task 3	Complete L1	Complete L2 with errors	Complete L2	10
4	Lab Task 4	Complete L1	Complete L2 with errors	Complete L2	10
5	Lab Task 5	Complete L1	Complete L2 with errors	Complete L2	10
6	Lab Task 6	Complete L1	Complete L2 with errors	Complete L2	10
7	Lab Task 7	Complete L1	Complete L2 with errors	Complete L2	10
8	Lab Task 8	Complete L1	Complete L2 with errors	Complete L2	10
9	Lab Task 9	Complete L1	Complete L2 with errors	Complete L2	10
10	Lab Task 10	Complete L1	Complete L2 with errors	Complete L2	10
11	Lab Task 11	Complete L1	Complete L2 with errors	Complete L2	10

COURSE CLEARANCE &EVALUATION CRITERIA:

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A student with shortage of attendance (i.e., less than 75% of the classes actually conducted in every Course in the concerned Academic shall not be permitted to appear in the End Term Final Examinations of the Course(s) in which the attendance shortfall exists, irrespective of the student's academic performance in the other components of CA. The student shall be given a placeholder grade "NP" (Not Permitted), to indicate that the student has not been permitted to appear for the End Term Final Examinations due to shortage of attendance during the Academic Term in the concerned Course(s).

A student failing to get the minimum requirement of 40% of the total marks/weightage assigned for components of Continuous Assessments (other than the End Term Final Examination), shall not be eligible to appear in the End Term Final Examination in the concerned Course. The student shall be given the grade "NE" (Not Eligible) as a placeholder grade in the concerned Course, to indicate that the student was not eligible to appear in the End Term Final Examination due to failure to obtain the minimum requirement of 40% of the total marks assigned for Continuous Assessments (other than the End Term Final Examination) in that Course.

The criteria in the Academic Regulations will over-ride the clearance criteria mentioned here if there are any differences.

MAKEUP POLICY:

Examination Make-up Policy: No make-up will be given for any evaluation component for the course.

CONTACT TIMINGS IN THE CHAMBER FOR ANY DISCUSSIONS:

Tuesday: 11:00 am to 12:25 pm

Saturday: 11:00 am to 4:00 pm

(Subject to change depending on the time-table)

Sample Thought Provoking Questions [For Theory Component] :

Sl No.	Question	Marks	Course Outcome No.	Bloom's Level
1	For a submarine moving in water, in which direction will the resultant of drag and buoyancy act? How will the resultant force change if the submarine is moving in air?	2	CO1	1
2	Can we make the game move faster without changing the car's velocity in the program code?	2	CO2	3
3	Two balls collide and said to intersect if the distance between their centers in smaller than the sum of their radii. Can we say that two rectangles will intersect if the distance between their centers is smaller than the sum of their diagonals?	3	CO3	3
4	Write the logic to make a ball move in the direction of the mouse while under the influence of gravity.	5	CO3	3

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Sample Thought Provoking Questions to be asked to Assess the Students' Preparedness to carry out the Task [For Laboratory Component] :

(Here type sample typical questions for students 'reference)

Sl No.	Question	Task No.	Course Outcome No.
1	If there is no mass, where will the center of mass be located?	1	CO1
2	How will the object move if gravity has negative value?	2	CO1
3	If a child is jumping on a spring, can we say that the coefficient of restitution is greater than 1?	3	CO1
4	Apply principles of energy conservation in a program where ball bounces in a no gravity box	4	CO3

Sample Assignment Questions:

(Here type sample typical questions for students 'reference)

Sl No.	Question	Course Outcome No.
1	Display a moving image on the screen. Make the image as a class object. Use class functionality to make multiple copies of the object.	CO3
2	Use the given code for a car game and add multiple levels with differing complexities	CO4
3	Make your photo move randomly on the screen	CO3
4	Write a program applying Euler's method to calculate the position of a projectile. How different is it when you apply RK4 method under same conditions? Are you aware of other methods?	CO2

Target set for course Outcome attainment:

Sl. No	C.O. No.	Course Outcomes	Target set for attainment in percentage
01	CO1	Identify various physics concepts applied in computer games and virtual reality environments.	60
02	CO2	Convert Physics concepts into mathematical language.	55

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03	CO3	Model simplified real life physics phenomenon in a computer programing language	55
04	CO4	Collate parts of pre-written code to produce a working program which includes applied concepts of physics	60

Signature of the Course Instructor

This course has been duly verified Approved by the D.A.C.

Signature of the Chairperson D.A.C.

Course Completion Remarks &Self-Assessment.[*This has to be filled after the completion of the course*]

[Please mention about the course coverage details w.r.t. the schedule prepared and implemented. Any specific suggestions to incorporate in the course content. Any Innovative practices followed and its experience. Any specific suggestions from the students about the content, Delivery, Evaluation etc.]

Sl. No.	Activity As listed in the course Schedule	Scheduled Completion Date	Actual Completion Date	Remarks
01	Over View of the course	12-Sep-2022	12-Sep-2022	
02	Module: 01	13-Sep-2022	7-Oct-2022	
02	Module: 02	10-Oct-2022	02-Nov-2022	
03	Midterm	3-Nov-2022	12-Nov-2022	
04	Module: 03	14-Nov-2022	9-Dec-2022	
05	Module: 04	12-Dec-2022	30-Dec-2022	
	Last Instruction Day		31-Dec-2022	

Any specific suggestion/Observations on content/coverage/pedagogical methods used etc.:

Course Outcome Attainment:

Sl. No.	C.O. No.	Course Outcomes	Target set for attainment in percentage	Actual C.O. Attainment In Percentage	Remarks on attainment & Measures to enhance the attainment
01	CO1	Identify various physics concepts applied in computer games and virtual reality environments.	60		
02	CO2	Convert Physics concepts into mathematical language.	55		
03	CO3	Model simplified real life physics phenomenon in a computer programing language	55		
04	CO4	Collate parts of pre-written code to produce a working program which includes applied concepts of physics	60		

Name and signature of the Course Instructor:

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D.A.C. observation and approval:

BLOOM'S TAXONOMY

Learning Outcomes Verbs at Each Bloom Taxonomy Level to be used for writing the course Outcomes.

Cognitive Level	Illustrative Verbs	Definitions
Knowledge	arrange, define, describe, duplicate, identify, label, list, match, memorize, name, order, outline, recognize, relate, recall, repeat, reproduce, select, state	remembering previously learned information
Comprehension	classify, convert, defend, discuss, distinguish, estimate, explain, express, extend, generalize, give example(s), identify, indicate, infer, locate, paraphrase, predict, recognize, rewrite, report, restate, review, select, summarize, translate	grasping the meaning of information
Application	apply, change, choose, compute, demonstrate, discover, dramatize, employ, illustrate, interpret, manipulate, modify, operate, practice, predict, prepare, produce, relate schedule, show, sketch, solve, use write	applying knowledge to actual situations
Analysis	analyze, appraise, breakdown, calculate, categorize, classify, compare, contrast, criticize, derive, diagram, differentiate, discriminate, distinguish, examine, experiment, identify, illustrate, infer, interpret, model, outline, point out, question, relate, select, separate, subdivide, test	breaking down objects or ideas into simpler parts and seeing how the parts relate and are organized

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Synthesis	arrange, assemble, categorize, collect, combine, comply, compose, construct, create, design, develop, devise, explain, formulate, generate, plan, prepare, propose, rearrange, reconstruct, relate, reorganize, revise, rewrite, set up, summarize, synthesize, tell, write	rearranging component ideas into a new whole
Evaluation	appraise, argue, assess, attach, choose, compare, conclude, contrast, defend, describe, discriminate, estimate, evaluate, explain, judge, justify, interpret, relate, predict, rate, select, summarize, support, value	making judgments based on internal evidence or external criteria

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