Guidelines for the Certification courses

1. The emerging technologies courses would be offered as Certification courses to improve the student knowledge and skills during the vacations.
2. It would be offered to the 5th sem students (2021 scheme onwards) as a 30 hours course.
3. A CGPA of 6 and above is required to register for the Certification course.
4. No credits would be associated with the certification courses.
5. The Certification course would be conducted in the vacation for a period of 1 week (4 to 5 hours daily in 2 sessions).
6. The sessions would be consisting of theory classes and hands on experience (in labs).
7. Students would be encouraged to bring laptops to class inorder to reduce the load on CC resources & promote the BYOD model for better interaction & learning.
8. The sessions would be engaged by 2 faculty members ideally (max 3) working in the CoE, lab or the emerging technology.
9. Wherever possible, 1 external expert could also be involved from local startups or industries working in the emerging technology.
10. The batch size should consist of a minimum of 30 students inorder to run the certification course.
11. Attendance of 100% is required to be eligible for the examinations and the Certification.
12. Examination pattern can be MCQ type, written, viva voce, project based or hands on/ practical oriented based on the type of certification course. It will be mentioned in the syllabus.
13. Grading in the certificate will be based on the Absolute system being followed for 2021 & 2022 scheme. Letter grade will be printed on the certificate based on the marks scored. The Certificate will be issued by the offering department.
14. The Introduction/Orientation session to Certification courses would be given after the 2nd IA test followed by registration by the students after paying the full fees.
15. It is decided to collect the following fees for the Certification programs.
    A. Rs 1000 for GIT students
    B. Rs 2000 for external students/participants
    C. Rs 3000 for Industry participants
16. No Refund will be given to ongoing certification courses.

Certification course

Introduction to Artificial Intelligence and Machine Learning

Total Contact Hours	Lecture = 02 Hours Practical = 02 Hours Total = 30 Hours	**CIE Marks**	100
Semester in which the course is offered	V		

Objectives of the Certification course	
1.	To understand various concepts of artificial intelligence and machine learning
2.	To demonstrate fundamental programming capabilities in Python
3.	To comprehend the working of basic machine learning algorithms
4.	To apply artificial intelligence and machine learning techniques to real world problems

Pre-requisites: Basics of Python programming, Mathematics involving statistics, probability

Topic – I	**Contact Hours = 03 Hours**
Introduction to Artificial Intelligence and Machine Learning: Meaning and scope of AI, Stages of Artificial Intelligence, Relationship between AI and ML, Applications of Artificial Intelligence.	

Topic – 2	**Contact Hours = 06 Hours**
Python Basics: Datatypes, Control Statements – Decision-Making and Iteration Constructs, High level Data Constructs – Working with Lists, Tuples and Dictionaries	

Topic – 3	**Contact Hours = 08 Hours**
Python Packages: NumPy – Creating and working with ndarrays, Pandas – Creating and working with dataframes, Matplotlib – Plotting and Visualization, Scikit-Learn – A tool for Predictive Analysis	

Topic – 4	**Contact Hours = 06 Hours**
Basic Machine Learning I: Definition and Features of Machine Learning, Machine Learning Approaches, Linear Regression, Logistic Regression, Naïve Bayes algorithm	

Topic – 5	**Contact Hours = 07 Hours**
Basic Machine Learning II: Decision Trees and Random Forests, Support Vector Machines, K-means Clustering, , Model building and evaluation, Performance Metrics	

Reference materials	
1.	Ben Coppin, Artificial Intelligence Illuminated, Jones and Bartlett, 2004
2.	Tom M. Mitchell, “Machine Learning,” Mcgraw-Hill Education (Indian Edition),2013
3.	Elaine Rich Kevin Knight, Shivashankar B Nair: Artificial Intelligence, Tata McGraw Hill 3rd edition 2013.

4.	Stuart Russel, Peter Norvig: Artificial Intelligence A Modern Approach, Pearson 3rd edition 2013.
5.	Ethem Alpaydin, "Introduction to Machine Learning", 2nd Edition, PHI Learning Pvt. Ltd., 2013.
	Links of E-resources
6.	https://nptel.ac.in/courses/106105077
7.	https://nptel.ac.in/courses/106106139

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations		

Course Outcome (COs) At the end of the course, the student will be able to:				
Learning Levels: Re - Remember; Un - Understand; Ap – Apply: An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Explain** the underlying concepts of AI and ML	Un	1	1
2.	**Implement** basic machine learning algorithms	Ap	1,2,3,5,12	1,2,3
3.	**Apply** the learnings inculcated throughout the course and **develop** a course project	An	1,2,3,5,9,10,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	**Test (1 Number)**	**Total**
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz: 1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test: 1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY** in order **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks for a maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥ 40% of Total marks to pass the certification course.
3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can be done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation.

	B. Theoretical courses can have Descriptive Questions in the Test. C. Other courses which are lab based can have numerical, experiment-based questions.

CO-PO Mapping (planned)													CO-PSO Mapping (planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√												√		
2	√	√	√		√							√	√	√	√
3	√	√	√		√				√	√		√	√	√	√

Name & Signature of Faculty members offering the course

AI Working Group (AIWG)

Dr. Swetha I. Goudar
Professor, MCA
Head – AIWG

Dr. Padma Dandannavar
Asso. Prof., ISE

Dr. Manjula Ramannavar
Asso. Prof., CSE

Dr. Uttam Deshpande
Asso. Prof., ECE

Certification course Syllabus
Cyber Security: A Practical Approach

Total Contact Hours	Lecture = 8 Hours Practical = 22 Hours Total = 30 Hours	**CIE Marks**	100
Semester in which the course is offered	5th sem students (2021 scheme onwards)		

Objectives of the Certification course
• To understand the basics of cybersecurity and get familiar with cybersecurity analysis tools. • To learn about security threats and countermeasures • To gain knowledge on tools and methods used in pentesting.

Pre-requisites: Basic understanding of internet and computers.

Topic – I Introduction to Cyber Security	**Contact Hours = 5 Hours**
Theory/Practical/demonstration	**1/2/2**
Introduction to Information Security and its policies: CIA Triad-3 pillars of information security architecture, CIA components and its importance, Cyber security threats and best practices, Access controls and its types, Types of Cyber Attack, Vulnerability Assessment and its features, Concept and types of Scanning Methodology, Penetration Tests. Installation of Linux Based Operating System, Basic Linux Commands, Commands for security professionals (mainly AppSec and Pentesters), Common ports and protocols like 22, 25, ssh, https, How DNS works, How SSL works, What are the common network threat around these, MiTM, Network sniffing, Various TCP attacks, DoS and DDoS attacks and its preventions, Common ideas on firewall or Software defined networks, Basic network troubleshooting like why internet is slow or down, why wi-fi is not working, open networks issues et al.	
Self Study: Active Reconnaissance, Types of Reconnaissance, Passive Reconnaissance	

Topic – 2 Cryptography and Firewalls	**Contact Hours = 5 Hours**
Theory/Practical/demonstration	**1/2/2**
Introduction to cryptography, Cryptography and Cryptanalysis, Types of cryptograpy, Hash Cryptography, understanding digital certificates and signatures, Types of cryptographic attacks, Working with Cryptool and Applications of Cryptography.	
Types of Firewalls and its benefits, Stateful vs. Stateless Filtering Firewall and firewall detection tools	
Self-Study: Traditional cryptographic attacks	

Topic – 3 Web Application Security and Pentesting	**Contact Hours = 20 Hours**
Theory/Practical/demonstration	**6/4/10**
Understanding of various HTTP methods, Understanding response status codes. Understanding HTTP Headers.	
Practical & demonstration of the following Tools	
Kali Linux, Nmap, Metasploit, Shodan, Wireshark & Burp Suite	
Self Study: PUT vs POST, UPDATE vs PATCH	

Reference materials	
1.	**Text Books**
	Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, 2011, First Edition (Reprinted 2018).
	William Stallings, Cryptography and Network Security, Pearson 6th edition
	Michael Gregg, Omar Santos, Certified Ethical Hacker (CEH) Version 10 Cert Guide,Pearson IT Certification, 3rd Edition, 2019
2.	**E-resources (NPTEL/SWAYAM.. Any Other)- mention links**
	EC Council Cyber Security Courses https://www.eccouncil.org/
	SWAYAM Course on Cyber Security https://onlinecourses.swayam2.ac.in/cec20_cs15/preview
	CISCO https://skillsforall.com/course/introduction-to-cybersecurity?courseLang=en-US
	NPTEL Course on Cyber Security and Privacy By Prof. Saji K Mathew, IIT Madras https://onlinecourses.nptel.ac.in/noc23_cs127/preview
	https://www.udemy.com/course/cybersecurity-law-policy
	https://academy.apnic.net/en/course/introduction-to-cybersecurity
	https://www.coursera.org/specializations/intro-cyber-security
	https://www.coursera.org/learn/cybersecurity-for-everyone
	https://www.classcentral.com/tag/cybercrime

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations		

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Interpret** the fundamental principles of information security, including the CIA Triad, access controls, and types of cyber attacks, establishing a solid foundation in cybersecurity concepts.	L2	1	1
2.	**Infer** the cryptographic principles and firewall technologies, enabling them to make informed decisions in selecting and implementing cryptographic solutions and evaluating the effectiveness of firewall measures.	L2	1, 5, 9, 12	1
3.	**Apply** penetration testing methodologies and tools, such as Metasploit and Shodan, to identify and exploit vulnerabilities in real-world scenarios, demonstrating practical proficiency in ethical hacking.	L3	5, 8, 9 12	1,3

4.	**Analyze** network protocols, vulnerabilities, and web application security using tools like Wireshark and Burp Suite, showcasing the ability to assess complex security scenarios and formulate strategic mitigation plans.	L4	5, 8, 9 12	1,3

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz: 1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test: 1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY** inorder **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks for a maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥ 40% of Total marks to pass the certification course.
3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation. B. Theoretical courses can have Descriptive Questions in the Test. C. Other courses which are lab based can have numerical, experiment-based questions.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√												√		
2	√				√				√			√	√		
3					√			√	√			√	√		√
4					√			√	√			√	√		√
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members offering the course

Prof. Sagar Pujar
Dr. Pijush Barthakur
Dr. Bhagyashree Pandurangi
Dr. Manjunath Managaluli

HOD

Dr. Sanjeev Sannakki

Cognitive Computing and Visual Perception

Total Contact Hours	Lecture = 15 Hours Practical = 15 Hours Total = 30 Hours	**CIE Marks**	100
Semester in which the course is offered	5th, 6th, 7th sem BE students		

Objectives of the Certification course
1. Understand the fundamental principles of cognitive computing and visual perception.
2. Apply linear algebra techniques for practical problem-solving in image processing.
3. Evaluate and critique cognitive models and algorithms in the context of image processing.

Pre-requisites : Basics of Mathematics & fundamental python programming

Topic – 1 Cognitive Computing and Visual Perception	**Contact Hours = 6 Hours**
Introduction: Definition of Cognition, Cognitive Computing , Defining and Understanding Cognitive Computing, Cognitive Computing Evolution and Importance, Difference Between Cognitive, Computing and Artificial, Intelligence, The Elements of a Cognitive System. Machine Learning Techniques, Developing a Cognitive Computing Application, Advantages of Cognitive Computing, Features of Cognitive Computing, Limitations of Cognitive Computing. **Visual Perception** - Visual Perception – Introduction, Digital Images, Low Level Vision, Medium Level Vision High Level Vision.	

Topic – I Foundations of Programming and Linear Algebra	**Contact Hours = 8 Hours**
Foundations of Programming with Python and PyTorch - Introduction to Python, NumPy, SciPy, and Matplotlib for Scientific Computing, Data Manipulation with Pandas, Introduction to PyTorch for Deep Learning, Exploratory Data Analysis (EDA) with Python, **Class room project demonstration.** **Linear Algebra** Fundamentals of Linear Algebra, Statistical Concepts for Data Analysis, Linear Algebra Applications in Machine Learning, Statistical Analysis with Python, Practical Linear Algebra and Statistics, **Class room project demonstration**	

Topic – 2 Computer Vision Basics and DNN Fundamentals	**Contact Hours = 8 Hours**
Introduction to Computer Vision (CV) - Basics of Digital Image Processing, Image Processing and Computer Vision Fundamentals, Applications of Computer Vision, Challenges and Advances in Computer Vision, **Class room project demonstration.** **Deep Neural Networks (DNN) -** Introduction to Artificial Neural Networks (ANN), From ANN to Deep Neural Networks (DNN), Convolutional Neural Networks (CNN) for Image Processing, Recurrent Neural Networks (RNN) for Sequential Data, Applications of DNN in Computer Vision and Natural Language Processing (NLP), **Class room project demonstration.**	

Topic – 3 Advanced Topics in Computer Vision and Natural Language Processing	Contact Hours = 8 Hours
Generative Adversarial Networks (GANs) in Vision, Attention Mechanisms in NLP: Transformer Architecture (Vision Transformer –ViT), **Class room project demonstration.**	

Books	
	Text Books:
1.	Christopher M. Bishop - "Pattern Recognition and Machine Learning" - Springer, 1st Edition, 2006.
2.	Kevin P. Murphy - "Machine Learning: A Probabilistic Perspective" - MIT Press, 2012.
3.	Vishal Jain, Akash Tayal, Jaspreet Singh, Arun Solanki –"Cognitive Computing Systems: Applications and Technological Advancements", Apple Academic Press, 2021
4.	Kolla Bhanu Prakash, G. R. Kanagachidambaresan, et al. – "Cognitive Engineering for Next Generation Computing: A Practical Analytical Approach", Wiley 2021.
	Reference Books:
1.	Richard O. Duda, Peter E. Hart, and David G. Stork - "Pattern Classification" - Wiley, 2nd Edition, 2000.
2.	Trevor Hastie, Robert Tibshirani, and Jerome Friedman - "Elements of Statistical Learning: Data Mining, Inference, and Prediction" - Springer, 2nd Edition, 2009.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations		

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	**Understand** machine learning concepts and their applications.	Un	1,2,12	1,2
2.	**Apply** supervised learning algorithms for classification and regression tasks.	Ap	1,2,12	1,2
3.	**Analyze** and implement deep learning techniques for complex pattern recognition and image analysis tasks.	An	1,2,12	1,2,3
4.	**Evaluate** and compare machine learning models,	Ev	1,2,6,7,9,1	1,2,3

	addressing overfitting challenges.		2	

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz: 1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test: 1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY** inorder **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks for a maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥ 40% of Total marks to pass the certification course.
3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation. B. Theoretical courses can have Descriptive Questions in the Test. C. Other courses which are lab based can have numerical, experiment based questions.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓	✓			✓							✓	✓	✓	
2	✓	✓			✓							✓	✓	✓	
3	✓	✓			✓		✓	✓	✓	✓		✓	✓		
4	✓	✓			✓							✓	✓	✓	✓

Name & Signature of Faculty members
Faculty members involved in designing the syllabus

Name & Signature of
verifying/approving the syllabus

Certification course on Electric Vehicles and Mobility

Total Contact Hours	Lecture =24 Hours Practical = 06 Hours Total = 30 Hours	**CIE Marks**	100
Semester in which the course is offered			

Objectives of the Certification course
1. To understand the overview of electric vehicles (EV) with respect to Indian and global context & comparison between conventional IC engine (ICE) and EV. 2. To understand the architecture and configuration of EV and ICE 3. To design the battery system for EV and analyzing performance parameters. 4. To analyze the functions of BMS in EV. *5.* To understand assembling of EV components and demonstrating it practically.

Pre-requisites : Physics

Topic – I: Introduction to Electric Vehicles	**Contact Hours = 6 Hours**
Conventional IC Engine (ICE) vehicles: Structure and working of ICE vehicles, comparison of ICE vehicles and Electric vehicles (EV). **Overview of EV:** History of EV, evolution and current trends, Types of EV- Battery operated Electric Vehicles (BEVs), Plug-in Hybrid Electric Vehicles (PHEVs) and Hybrid Electric Vehicles (HEVs), advantages of electric vehicles.	

Topic – 2: EV Architecture	**Contact Hours = 6 Hours**
EV subsystems and key components-electric motor, battery, power electronic converters-functions and architecture. Types of EV batteries and their features, overview of emerging EV battery technologies, EV Power train architecture, comparison of ICE power train architecture with Electric vehicles power train.	

Topic – 3: Sizing of Battery & Motor for EVs	**Contact Hours = 6 Hours**
Battery parameters: Voltage rating- cut off voltage, maximum charge voltage, open circuit voltage, terminal voltage, Ah rating, C-Rating, Specific Energy density, Specific Power density, selection of battery for EV (energy density, size & weight, terminal voltage, mechanical withstanding, temperature, maintenance, safe).	

Topic – 4: Battery management system (BMS)	**Contact Hours = 6 Hours**
Functions of BMS, BMS architecture, Battery monitoring-SOC, DOD, SOH, Cell Balancing, Cell Safety**.**	

Topic – 5: Practical assignments on EV	**Contact Hours = 6 Hours**

Hands on learning of assembling the different components of EV such as battery, motor, controller, throttle, lighting system, etc, and testing the same.

Reference materials	
1.	Electric Vehicle Engineering, Per Enge, Nick Enge, Stephen Zoepf, McGraw Hill , 1st Edition 2021
2	Electric Vehicle Technology, Prof. Suresh Pawar, Notion Press, September 2021.
2.	https://onlinecourses.nptel.ac.in/noc18_ge09/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations		

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Compare conventional and electric vehicles and Explain the need of EV in transportation industry highlighting the impact on global economy & environment.	Un	1,6,7,12	1
2.	Explain the architecture of EV and ICE.	Un	1,12	1
3.	Design the size of battery and selection of battery for EV applications.	Ap	1,7,12	1,3
4.	Test and demonstrate the understanding of EV assembling.	An	2, 3, 4, 9, 10, 12	1,3

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz: 1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test: 1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY** inorder **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks for a maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥ 40% of Total marks to pass the certification course.
3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation. B. Theoretical courses can have Descriptive Questions in the Test. C. Other courses which are lab based can have numerical, experiment based questions.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓					✓	✓					✓	✓		
2	✓											✓	✓		
3	✓						✓					✓	✓		✓
4		✓	✓	✓					✓	✓		✓			
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members offering the course HOD

Certification course Syllabus Template
3D Printing

Total Contact Hours	Lecture = 15 Hours Practical =15 Hours Total = 30 Hours	**CIE Marks**	100
Semester in which the course is offered	5th semester		

Objectives of the Certification course
Enable students to understand the principle and have a hands-on experience on the working of 3D printers, 3D Scanner, extrusion of 3D printing filaments and ultrasonic welding machine employed to join 3D printed components.

Pre-requisites: Elementary knowledge of designing basic CAD models as well as conventional manufacturing processes.

3D Printing Technology (Additive Manufacturing)	**Contact Hours = 8 Hours**
Introduction to 3D printing technology, Demonstration of the working of a FDM-3D printer, **Hands on** the working of an FDM-3D printer – Preparing a CAD model, STL file generation, Setting various parameters in the machine controller software, G-code generation, Setting up the 3D printer, Printing the model, Mini project.	

3D Scanning (Reverse Engineering)	**Contact Hours = 6 Hours**
Post-processing, Slicing, repairing a CAD model using NETFABB software, Pricing a 3D product, Introduction to 3D Scanning technology, Demonstration of the working of the 3D scanner, **Hands on** a 3D Scanner – Acquisition, Alignment, Mesh generation, Post processing, Simplification.	

Extrusion Process for 3D printing	**Contact Hours = 6 Hours**
Introduction to Extrusion process, Demonstration of the working of the Single Screw extrusion machine, **Hands on** the extrusion process – heating up the extruder, rotation of the screw, pellet addition, extrusion, cooling, winding up the extruded filament.	

Joining/welding of 3D printed parts	**Contact Hours = 6 Hours**
Introduction to the joining processes in 3D printing, demonstration of Adhesive bonding, Friction Stir Welding, Friction Stir Spot Welding, Spin Friction Welding, Microwave Welding, **Hands on** Ultrasonic Welding of 3D printed parts.	

Interactions and industrial visits	**Contact Hours = 4 Hours**
An interactive session with 3D printing professionals and hobbyists, a visit to a local 3D Printer manufacturing vendor.	

Reference materials	
Books:	
1.	Ian Gibson, David Rosen, Bent Stucker, Additive Manufacturing Technologies, 3D printing, Rapid Prototyping, and Direct Digital Manufacturing, Springer, 2015, 2nd Edition, 2015.
2.	Ramesh S., Rapid Prototyping, Ane books Pvt. Ltd., 2016.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations		

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand** the basic working principles and working of a 3D Printer.	L1	1	1
2.	**Apply** the knowledge of rapid prototyping to reverse engineer a component.	L3	1,2	1,2
3.	**Understand** the working principle of a screw extruder machine for drawing a filament.	L1	1	1
4.	**Apply** the knowledge to produce a product using 3D printing technique and become a successful 3D printer system operator, senior 3D printer system operator or a prototyping engineer.	L3	12	1

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz:

1. Questions can be MCQ type, fill in the blanks, True/False etc
2. Quiz can be conducted during/after the classes.

Eligibility for Test:

1. Minimum of 90% attendance in the classes conducted.
2. Passing the **Test is COMPULSORY** inorder **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks for a maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥ 40% of Total marks to pass the certification course.

3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation. B. Theoretical courses can have Descriptive Questions in the Test. C. Other courses which are lab based can have numerical, experiment-based questions.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓												✓		
2	✓	✓											✓	✓	
3	✓												✓		
4												✓	✓		
Tick mark the CO, PO and PSO mapping															

Dr. Vivek Tiwary, Dr. Arunkumar P., Dr. Vinayak Malik
Name & Signature of Faculty members offering the course HOD

Certification course Syllabus Template
Robotics

Total Contact Hours	Lecture = 15 Hours Practical = 15 Hours Total = Hours	**CIE Marks**	100
Semester in which the course is offered	UG: 5^{th}, 6^{th}, 7^{th} PG: 1^{st}, 2^{nd}, 3^{rd}		

Objectives of the Certification course
1. To understand the basic principles and history of robotics and define key terms and concepts related to robotics. 2. To learn the fundamentals of electronics and common electronic components used in robotics. 3. To develop basic programming skills for controlling robotic systems. 4. To understand how to design and assemble simple robotic structures. 5. To learn how to interface and integrate sensors into a robotic system. 6. To develop problem-solving skills through practical applications.

Pre-requisites : C programing, Matrices and Kinematics of Machines

Topic – I	**Contact Hours = 10 Hours**
Introduction to robotics and demonstration of different robot elements and their function. Introduction to robot kinematics and control.	

Topic – 2	**Contact Hours = 10 Hours**
Introduction and demonstration to the sensors and actuators used in the industry robots. Basic robot programming concepts including 3D transformations and kinematics for controlling robot manipulators. (Visit to industry)	

Topic – 3	**Contact Hours = 10 Hours**
Demonstration of different robots like SCARA, AMRs etc. and the working of various sensors in the industry. Building simple robots for applications like medical, Household, Entertainment, Space, Underwater, Defense, Disaster management etc. (Hands on experience)	

Reference materials	
1.	Pratihar.D.K, “Fundamentals of Robotics”,Narosa Publishing House,India,2019
2.	Groover Mikell. P, “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2014
3.	Fu. K.S, Gonzalez. R.C, Lee. C.S.G “Robotics –Control, Sensing, Vision, and Intelligence”, McGraw Hill, 2015
4.	Siegwart,R Nourbakhsh, and Scaramuzza, “Introduction to Autonomous Mobile Robots”, MIT Press, USA, 2011.

1.	Links of E-resources **Robotics: Advanced Concepts and Analysis, IISc Bangalore** https://nptel.ac.in/courses/112108093
2.	https://archive.nptel.ac.in/courses/112/108/112108093/

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions at industry	3.	Presentation
4.	Demonstrations/hands on		

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain the foundational understanding of robotics.	2	1	1
2.	Interpret various sensors and actuators commonly used in robotics, including their functionalities and applications.	3	1,4	1
3.	Demonstrate proficiency in basic robot programming, including 3D transformations and kinematics necessary for controlling robot manipulators.	3	1	1
4.	Design and construct simple robots tailored for specific applications.	4	1,4,9, 12	1

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	**Test (1 Number)**	**Total**
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz: 1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test: 1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY** in order **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks for a maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥ 40% of Total marks to pass the certification course.
3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation.

	B. Theoretical courses can have Descriptive Questions in the Test. C. Other courses which are lab based can have numerical, experiment based questions.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓												✓		
2	✓			✓									✓		
3	✓												✓		
4	✓			✓					✓			✓	✓		
Tick mark the CO, PO and PSO mapping															

Name and signature of Faculty members offering the course HOD

Dr. H. B. Kulkarni
Prof. A. A. Deshpande

Certification course on CNC Technology

Total Contact Hours	Lecture = 10 Hours Practical = 20 Hours Total = 30 Hours	**CIE Marks**	100
Semester in which the course is offered	5th Semester		

Objectives of the Certification course
1. To understand various concepts related to CNC Technology 2. To have practical purview of manual part programming at industry 3. To execute the manual part program on CNC machine at industry

Pre-requisites: Basics of metal machining

Topic – I	**Contact Hours = 10 Hours**
Introduction to CNC technology : CNC machines & controls. History & development of CNC technology. Conventional Vs. non-conventional machine tool. Numerical control on CNC machine tools. CNC Control and types of CNC control. Basic safety. CNC programming basics. Introduction to manual NC programming. Manual NC programming for lathe & milling machines. Application Numerical Control, Advantages, & Disadvantages.	

Topic – 2	**Contact Hours = 08 Hours**
Introduction to CNC programming: Basic understanding of G and M codes on the machine. Introduction and demonstration of line programs. Procedures Associated with part programming, Cutting process parameter selection, Process planning issues and path planning, G & M Codes, Interpolations, Canned Cycles and Subprograms, Tool compensations. Exposure to FANUC Controls.. Machining of programmed exercise on CNC lathe & milling machines	

Topic – 3	**Contact Hours = 12 Hours**
Programming exercise: Execute program and inspect simple geometrical forms of standard parts. 1. Facing, plain turning, step turning and taper turning 2. Facing, step turning and circular interpolation 3. Face milling and end milling 4. Facing and Drilling	

Reference materials	
1.	Mechatronics and Machine Tools, HMT Limited, McGraw Hill Higher Education, ISBN-13 : 978-0071346344,1998
2.	https://nptel.ac.in/courses/112105211
3.	https://nptel.ac.in/courses/112105306

Course delivery methods		Assessment methods	
1.	PPT and Videos	1.	Quiz
2.	Practical/programming sessions at industry	2.	Test- Project /lab based
3.	Demonstrations	3.	Presentation
4.	Chalk and Talk		

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain the concept of CNC programming on various machines.	L2	1	1
2.	Apply G and M codes to run the CNC program and subprogram for various machine applications	L3	1,2,12	1
3.	Execute a full program on CNC turning	L3	1,2,5,12	1
4.	Execute a full program on CNC mill	L3	1,2,5,12	1

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz:
1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test:
1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY** in order **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks for a maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥ 40% of Total marks to pass the certification course.
3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation. B. Theoretical courses can have Descriptive Questions in the Test. C. Other courses which are lab based can have numerical, experiment-based questions.

CO-PO Mapping (Planned)	**CO-PSO Mapping**

													(Planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	**√**												**√**		
2	**√**	**√**										**√**	**√**		
3	**√**	**√**			**√**							**√**	**√**		
4	**√**	**√**			**√**							**√**	**√**		
Tick mark the CO, PO and PSO mapping															

Dr. Sachin C. Kulkarni & Prof.Roopa R.Navalli

Name & Signature of Faculty members offering the course HOD

Certification course Syllabus Template
Mechatronics

Total Contact Hours	Lecture = 15 Hours Practical = 15 Hours Total = Hours	**CIE Marks**	100
Semester in which the course is offered	UG: 5^{th}, 6^{th}, 7^{th} PG: 1^{st}, 2^{nd}, 3^{rd}		

Objectives of the Certification course
1. To learn the fundamentals of Mechatronics and the concepts related to mechatronics
2. To understand how to drives and actuators are used in mechatronics.
3. To learn the fundamentals of smart materials and micromechatronics

Topic – I	**Contact Hours = 10 Hours**
Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface. Sensors and transducers: classification, Development in Transducer technology	

Topic – 2	**Contact Hours = 10 Hours**
Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems	

Topic – 3	**Contact Hours = 10 Hours**
Replacement Programmable Logic Controllers: Basic Structure, Types and Working Principle, Concept of Scan Cycle and Scan Time, IO's and its Types, Selection Criteria and Applications Programming Techniques: Ladder diagram –Concept of Contacts and Coil, Latching/ Holding Circuit, Memory Bits, Timers and Counter.	

Reference materials	
1.	*Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.).*
2.	Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
3.	*A Textbook of Mechatronics, R.K. Rajput, S. Chand & Company Private Limited*
4.	Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall.
1.	Links of E-resources https://nptel.ac.in/courses/112107298
2.	https://nptel.ac.in/courses/112103174

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions at industry	3.	Presentation
4.	Demonstrations/hands on		

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand the concepts of Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface.	2	1	1
2.	Understand the concepts of Programmable Logic Devices, Automatic Control and Real Time Control Systems.	2	1	1
3.	Apply the concepts of PLC for various mechatronic applications.	2	1	1

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz:
1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test: 1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY** in order **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks for a maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥ 40% of Total marks to pass the certification course.
3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation. B. Theoretical courses can have Descriptive Questions in the Test. C. Other courses which are lab based can have numerical, experiment based questions.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PSO**	**PSO**	**PSO**

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	✓												✓		
2	✓			✓									✓		
3	✓												✓		
4	✓			✓					✓			✓	✓		
Tick mark the CO, PO and PSO mapping															

Name and signature of Faculty members offering the course HOD

Composite Materials, Processing and Testing

Total Contact Hours	Lecture = 20 Hours Practical = 10 Hours Total = 30 Hours	**CIE Marks**	100
Semester in which the course is offered	5^{th} / 6^{th}		

Objectives of the Certification course
1) Train students on composite materials – definition, advantages and classification. 2) Equip students with knowledge on composite strengthening addition of components and their production routes. 3) Familiarize students about the processing and applications of composite structures.

Pre-requisites : Material Science, crystalline structure and properties of materials.

Topic – I	**Contact Hours = 08 Hours**
Introduction to Composites: Matrix Materials: Polymers, Metals, Ceramic Reinforcements: Glass Fibers, Boron Fibers, Carbon Fibers, Organic Fibers, Ceramic Fibers Interfaces: Wettability, Crystallographic Nature of Interface, Types of Bonding at the Interface Polymer Matrix Composites (PMC), Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMC).	

Topic – 2	**Contact Hours = 08 Hours**
Processing and properties of Composites: Hand layup processing of PMC, Vacuum Bagging for PMC, Liquid-State Processes and Solid State Processes in MMC, Cold Pressing and Sintering in CMC, Hot Pressing and reaction bonding process.	

Topic – 3	**Contact Hours = 14 Hours**
Practical/ Demonstration: 1) Preparation of PMC laminate using Hand layup technique. 2) Preparation of PMC laminate using Vacuum Bagging technique. 3) Making application oriented samples using composite materials with complex structures. 4) Testing of composites.	

Reference materials	
1.	K.K.Chawla, Composite Materials, 3rd Edition, springer, 2012.
2.	Deborah D.L. Chung, Composite Materials Science and Applications, 2nd Edition, springer, 2010.
3.	WD Callister, Jr., Adapted by R. Balasubramaniam, Materials Science and Engineering, John Wiley & Sons, NY, Indian edition, 2007.

4.	https://nptel.ac.in/courses/112104168

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations/ Industry visit		

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Identify and understand the basic mechanical behavior of composite materials and make sound prediction on the likely behavior of new combinations of materials.	L2	1	1
2.	Apply the choices made for using certain types of composites in certain applications with reference to composite properties.	L3	1, 3	1
3.	Demonstrate a practical understanding of composite properties and fabrication techniques, and to be able to make realistic suggestions for the evaluation of composite behavior, where appropriate.	L4	1	1

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz: 1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test: 1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY** inorder **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks for a maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥ 40% of Total marks to pass the certification course.
3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation. B. Theoretical courses can have Descriptive Questions in the Test.

	C. Other courses which are lab based can have numerical, experiment based questions.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	**√**														
2	**√**		**√**												
3	**√**														
Tick mark the CO, PO and PSO mapping															

Dr. T. T. Hawal / M. A. Kori HOD

Unmanned Aerial Systems

Total Contact Hours	L = 20 Hrs; T = 0 Hrs; P = 10 Hrs Total = 40 Hrs	**CIE Marks**	100
Semester in which the course is offered	V to VII Semester		

Course learning objectives	
1.	Learn about the various types of Drones and its applications.
2.	Understand about the various components of drone design.
3.	understand different types of sensors used in drone technology
4.	Classify different microcontrollers and flight controllers.

Pre-requisites : Engineering Mechanics , Engineering Mathematics

Unit – I: Introduction	**Contact Hours = 10 Hours**
Introduction , Types of Drones , Components of UAVs-Types of motors used for Drones –Several type of Speed Controllers, Flight Control Board, Radio Transmitter and receiver , Battery propellers,Power distribution board, Additional Equipment. Practical: Selecting and assembling drone components such as motors, batteries, flight controllers, Basic wiring and soldering techniques.	

Unit – II: Multi rotor Aerodynamics and Flight Mechanics	**Contact Hours = 10 Hours**
Lift and Thrust Pitch and roll, yaw, Translational Lift, Climbing, Hovering and Descent. Quad copter modeling representation-Frames –kinematic modeling –Euler angles, Quaternions and dynamic modeling. Case study: Quad copter Modeling with MATLAB/SIMULINK; Optimization of the Hubsan X4 and Build the X4Wii	

Unit – III: Drone Control Systems	**Contact Hours = 10 Hours**
Choosing a Flight control System-MultiWii, Dronecode, APM/ArduPilot,PX4/Pixhawk,DJI/Naza,KK2 and CC3D/Open Pilot. Sensors dedicated to flight control –IMU,INS,GPS, Magnetometer and barometer, Ground control systems sense and avoid technology. Case study: SIL and HIL Simulations With QGCS.	

Books	
	Reference Books:
1.	Yasmina Bestaoui Sebbane, “A First Course in Aerial robotics and Drones ”, PHI, `1st edition, 2022, ISBN- 0367631385.
2.	David Mcgriffy, Make: Drones: Teach an Arduino to Fly ,1st edition,2016,ISBN-13:978-

	1680451715.
3.	E. Tooley, Practical Drones: Building, Programming, and Applications, Apress, 2021.
4.	S. K. Kopparthy, Drone Technology: Theory and Practice, Springer, 2020.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.udemy.com/course/make_a_drone/: Make an Open Source Drone by Dr.Peter.

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations		

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Explain** the fundamental concepts and Regulations of Drone Technology, basic equations of Multi rotor dynamics.	Un	1,2,9,10	1
2.	**Derive** and **explain** various Drone Performance Parameters for various Applications.	Ap	1, 2,5	1
3.	**Explain** various types of Flight Control Systems to **determine** the suitable flight control system for the application.	Ap	1, 2,3,11	1

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	**Test (1 Number)**	**Total**
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz:

1. Questions can be MCQ type, fill in the blanks, True/False etc
2. Quiz can be conducted during/after the classes.

Eligibility for Test:

1. Minimum of 90% attendance in the classes conducted.
2. Passing the **Test is COMPULSORY**in order **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks for a maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥40% of Total marks to pass the certification course.
3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation.

	B. Theoretical courses can have Descriptive Questions in the Test. C. Other courses which are lab based can have numerical, experiment based questions.

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√	√							√	√			√		
2	√	√			√								√		
3	√	√	√								√		√		
Please Tick at appropriate place															

Name & Sign of faculty members involved in designing the syllabus	HOD
Mr. Anil Kumar Nakkala (Asst.Prof)	**Prof.P M Banakar**

Certification course Syllabus

Wind Tunnel Testing

Total Contact Hours	Lecture = 10 Practical = 20 Total = 30	**CIE Marks**	100
Semester in which the course is offered	6		

Objectives of the Certification course
The course should enable the students to: 1. To interpret the basic concepts of measurement of forces and moments on models during the wind tunnel testing. 2. To understand the application of various types of wind tunnels. 3. To learn the basic measurement procedure involving wind tunnel testing

Pre-requisites : Fluid Mechanics, Aerodynamics

WIND TUNNELS	**Contact Hours = 10**
Wind Tunnel, layouts and nomenclature, Types of Wind Tunnels – continuous and intermittent - closed circuit and open circuit - closed jet and open jet test section – application. Special purpose tunnels - Smoke Tunnels – Water Tunnels – Spin tunnel, automobile wind tunnel and environmental wind tunnel Important parameters of flow similarity. types of flow similarities for compressible and incompressible flows Model.	

FLOW VISUALIZATION TECHNIQUES	**Contact Hours = 10**
Path – Streak – Stream and Timelines; Techniques: Smoke, Tuft, Streaks, Surface oil flow. Velocity Measurements: Pivot Tube – Static and Total. Calibration of test section: Test section flow calibration and Boundary Layers.	

MEASUREMENTS OF FORCES AND MOMENTS	**Contact Hours = 10**
Forces, moments and Reference Frames – Balances – Internal and External - Requirements and Specifications – Fundamentals of Model Installations. Boundary correction. Pressure measurements: Manometers – U-Tube, Inclined and Precession. Bourdon Gauge and Pressure Transducer – Strain Gauge, Semi conductor – Absolute and Differential.	

Reference materials	
1.	1. Rae, W.H. and Pope, A. —Low Speed Wind Tunnel Testing‖, John Wiley Publication, 1999 2. Pope, A., and Goin, L., —High Speed wind Tunnel Testing‖, John Wiley Publication , 1999 3. Pope, J B Barlow —low speed wind tunnel testing — 3 edition j.w publication
2.	1. E L Houghton and PW Carpenter, "Aerodynamics for Engineering students", Fourth edition,Edward

	Arnold publications, 1993. 2. L.M Miline Thomson, —Theoretical Aerodynamics‖, 1996 McGraw-Hill,New Delhi

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations		

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Ability to understand basics of aerodynamics and to identify the type of wind tunnel**	4	1,9,12	1
2.	**Ability to develop and understand flow visualization techniques over model**	4	1,2,9,12	1,2
3.	**Ability to understand measurement and balancing of loads on model and to understand the different types of equipment's for measuring pressure and velocity.**	4	1,2,5,9,12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz: 1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test: 1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY** inorder **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks fora maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥40% of Total marks to pass the certification course.
3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation. B. Theoretical courses can have Descriptive Questions in the Test. C. Other courses which are lab based can have numerical, experiment based questions.

CO-PO Mapping													CO-PSO Mapping		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	**3**								**2**			**1**	**1**		
2	**3**	**1**							**2**			**1**	**1**	**2**	
3	**3**	**2**			**2**				**2**			**2**	**1**	**2**	
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members offering the course HOD

(Dharmendra A Ponnaswami)

Certification course Syllabus Template

Certification Course Title

Total Contact Hours	Lecture = 20 Hours Practical = 10 Hours Total = Hours	**CIE Marks**	100
Semester in which the course is offered	5th , 6th , 7th sem UG students		

Objectives of the Certification course
1. To introduce the concepts of Urban Planning and familiarize students with the Planning principles demonstrated through various civilizations. 2. To introduce the planning strategies and surveys used in planning of urban areas and preparation of the plans 3. To illustrate the urban infrastructure facilities. 4. To understand and apply the principles of RS, GIS and GPS in urban planning

Pre-requisites : Basic Surveying

History of Human Settlements	**Contact Hours = 07 Hours**
Introduction to Human Settlements: Origins, evolution and growth of settlements. History of City Planning: Introduction to planning principles of cities of ancient civilizations. Study of planning of ancient Indian cities and Indus Valley Civilization.	

Land use patterns	**Contact Hours = 07 Hours**
Land use and activity pattern, Density of population, population distribution. Central Business District, Neighbourhoods, urban nodes, fringe areas and suburbs. Models of land use planning like Concentric zone model, Sector theory model, Multiple nuclei model, neighbourhood planning and garden city concepts. Study and analysis of a residential layout in an urban area.	

Infrastructure Planning:	**Contact Hours = 03 Hours**
Water Supply: Water– sources of water, treatment and storage, transportation and distribution, quality, networks, distribution losses, water harvesting, recycling and reuse. Sanitation and Solid waste: Sanitation – points of generation, collection, treatment, disposal, norms and standards, grey water disposal. Electricity – Sources of electricity, distribution networks, demand assessment, norms and standards, planning provisions, and management issues. Social Infrastructure – Education, Health, Civic Transportation Systems - Role of transport, types of transport systems, Transportation surveys and studies.	

Geoinformatics in Urban planning:	**Contact Hours = 03 Hours**
Remote sensing: Elements, Satellite image interpretation, Multispectral bands concepts, Classification of satellite images, Land use and land cover classification. GIS: Spatial and Attribute Data, Data Structures - Raster and Vector data structures, GIS Software, and formats, Geo-database. Digitization, georeferencing, spatial and non-spatial data. Applications of GIS, Remote Sensing and GPS in Urban Infrastructure Planning, urban sprawl, Change detection studies.	

Practical aspects of Urban planning	**Contact Hours = 10 Hours**
Topographic sheet analysis, Georeferencing of maps, Digitization of map components in GIS, Planning and data base preparation, Classification of satellite data, Preparation of land use land cover maps, Demonstration of urban design layers and components.	

Reference materials	
1.	Chapin III F. Stuart , Kaiser Edward J. and Godschalk David R. , Urban Land Use Planning, University of Illinois Press, Illinois,1995 and onwards.
2.	Dutt, Binode Behari, Town Planning in Ancient India, Gyan Books Pvt. Ltd. , Delhi,2009
3.	Thomas Lillesand, Ralph W. Kiefer, and Jonathan W. Chipman. "Remote Sensing and Image Interpretation" Publisher: Wiley.
4.	S. K. Garg , Water Supply Engineering, (18th ed.), Khanna Publishers
5.	UDPFI Guidelines - Vol I - Urban Development Plan Formulation and Implementation Guidelines.
6.	Municipal solid waste management manual Part I & II. CPHEEO, India
7.	Hutchinson, B.G., Principles of Urban Transport Systems Planning, McGraw Hill, London, 1974.

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations		

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)			
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**

1.	**Apply** Basic principles of urban planning and Make use the planning strategies in their design.	Ap	6	3
2.	**Make use of** surveys, analyze and design a layout for a given area.	Ap	6	3
3.	**To understand** the planning principles of various civilizations.	Ap	6	3
4.	**Determine** the necessity of infrastructure facilities for urban areas.	Ap	6	3
5.	Apply RS and GIS technologies in urban and infrastructure planning	Ap	5	1

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz: 1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test: 1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY** inorder **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks for a maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥ 40% of Total marks to pass the certification course.
3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation. B. Theoretical courses can have Descriptive Questions in the Test. C. Other courses which are lab based can have numerical, experiment based questions.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1						✓									✓
2						✓									✓
3						✓									✓
4						✓									✓
5.					✓									✓	
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members offering the course
Prof. Shashank C. Bangi & Prof. Prof. Rashmi R. Pai

HOD
Dr. V. R. Chate & Dr. Rupali D. Kavilkar

Certification course Syllabus Template
Green Building

Total Contact Hours	Lecture = 20 Hours Practical =10 Hours Total = 30 Hours	**CIE Marks**	100
Semester in which the course is offered	5^{th}, 6^{th}, 7^{th} sem UG students		

Objectives of the Certification course
1. To study the green buildings towards sustainable development and its rating systems 2. To understand the need for sustainable building through traditional wisdom of design and construction. 3. To understand various materials used in construction of green buildings

Pre-requisites : Environmental studies

Topic – I: Introduction	**Contact Hours = 10 Hours**
Theory: Green builings and sustainable development: Typical features and benefits of green buildings toward sustainable living. Different aspects of sustainability like efficient use and control of Water, Energy, Earth, Waste and Materials. **Practical:** The students have to design a residence applying the concepts of green building and sustainability.	

Topic – 2: Green building rating systems and materials.	**Contact Hours = 10 Hours**
Theory: Green building rating systems: GRIHA, IGBC and LEED to give overview of criteria as per these rating systems. Study of eco-friendly and sustainable building materials and construction technologies **Practical:** The students will be divided in groups, each group studying the different literature case studies to understand the application of green building design concepts and then applying them in design.	

Topic – 3: Green building and sustainable concepts	**Contact Hours = 10 Hours**
Theory: Sustainable Concepts in Traditional Architecture in different climatic zones in Rural and Urban Context. **Practical:** The explorations of the studio to be produced in the form of sketches and drawings at the end of the course.	

Reference materials	
1.	Yatin Pandya, Sustainable Built Environment A Panorama, Footprints, E.A.R.T.H., (Environment. Architecture. Research. Technology. Housing), Ahmedabad.
2.	Mili Majumdar, Energy Efficient Buildings in India, Tata Energy Research Institute (TERI) and Ministry of Non-conventional Energy Sources, Govt. of India, 1997
3.	Charles J. Kibert, Sustainable Construction – Green Building Design and Delivery, John Wiley & Sons, New York, 2008.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations		

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand** the issues of Sustainability	L1	PO7	1
2.	**Explain** the concepts of traditional and contemporary approaches towards sustainable architecture	L2	PO7	2
3.	**Apply** and **design** sustainable techniques for a given project	L3	PO3	2

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz: 1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test: 1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY** inorder **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks for a maximum of 2 hours duration.
2.	**Minimum marks required to pass in the Test:** Score should be ≥ 24 marks, however overall score of Quiz + Test should be ≥ 40% of Total marks to pass the certification course.
3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation. B. Theoretical courses can have Descriptive Questions in the Test.

	C. Other courses which are lab based can have numerical, experiment based questions.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1							√						√		
2							√							√	
3			√											√	
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members offering the course HOD

Certification Course in Nanotechnology

Total Contact Hours	Lecture = 15 Hours Practical = 15 hours Total = 30 Hours	**CIE Marks**	100
Semester in which the course is offered	3rd to 8th Semesters during weekends		

Objectives of the Certification course
1. To provide a comprehensive overview of synthesis and characterization of nanoparticles, nanocomposites and hierarchical materials with nanoscale features. 2. To provide the engineering students with necessary background for understanding various nanomaterials characterization techniques 3. To develop an understanding of the basis of the choice of material for device applications

Pre-requisites : NIL

Topic – I Introduction to Nanomaterials	**Contact Hours = 10 Hours**
Theory/Practical/demonstration **Theory**: **(3 hrs)** Nanotechnology, Frontier of future-an overview, Length Scales, Variation of physical properties from bulk to thin films to nanomaterials, Confinement of electron in 0D, 1D, 2D and 3D systems. Synthesis of Nanomaterials: Bottom-Up approach: Chemical Routes for Synthesis of nanomaterials-Sol-gel, Precipitation, Solution Combustion synthesis. Top-Down approach- Ball milling technique, Sputtering, Laser Ablation, SILAR techniques **Practicals: (7 hrs)** 1) Preparation of silver nanoparticles and characterization of particle size by optical spectroscopy 2) Preparation of ZnO nanoparticles by combustion technique 3) Preparation of Al_2O_3 nanoparticles by precipitation method 4) Preparation of Silica nanoparticles by sol-gel method 5) Hydrothermal synthesis of metal oxide nanoparticles	

Topic – 2	**Contact Hours = 10 Hours**
Theory/Practical/demonstration **Theory**: Basic principles and instrumentations of Electron Microscopy –Transmission Electron Microscope, Scanning Electron Microscope, Scanning Probes- Scanning Tunneling microscope, Atomic Force Microscope –different imaging modes, Basic principles of working of X-ray diffraction, derivation of Debye-Scherrer equation, numericals on Debye Scherrer equation, Optical Spectroscopy-Instrumentation and application of IR, UV/VIS (Band gap measurement) Solar cells: First generation, Second generation and third generation solar cells: Construction and working of Dye sensitized and Quantum dot sensitized solar cells. Batteries: Lithium ion battery- working, Requirements of anodic and cathodic materials, classification based on ion storage mechanisms, limitations of graphite anodes, Advances in Cathodic materials, Anodic materials, Separators	

Topic – 3	Contact Hours = 10 Hours

Theory/Practical/demonstration

Theory: (2hrs) Fuel Cells: Introduction, construction, working of fuel cells and nanotechnology in hydrogen storage and proton exchange membranes. Switching glasses, Semiconductor devices including LEDs and Photonic crystals (1D, 2D and 3D) and their applications, Display devices.

Practicals: (8 Hrs)

1) Nanotechnology in Civil Engineering (Photocatalysis)
2) Nanotechnology in Mechanical Engineering (Nano fluids preparation)
3) Thermal Conductivity measurement of Nanofluids
4) Nanotechnology in Electrical and Electronics (Working of Electrochemical Sensors)
5) Working of Supercapacitors

Reference materials	
1.	**Text Books:** 1. Nano Materials – A.K. Bandyopadhyay/ New Age Publishers 2. Nanocrystals: Synthesis, Properties and Applications – C.N.R. Rao, P. John Thomas and G. U. Kulkarni, Springer Series in Materials Science 3. Nano Essentials- T. Pradeep/TMH **Reference Books:** 1. Introduction to Nanotechnology, C. P. Poole and F. J. Owens, Wiley, 2003. 2. Understanding Nanotechnology, Scientific American 2002. Nanotechnology, M. Wildon, K. Kannagara, G. Smith, M. Simmons and B. Raguse, CRC Press Boca Raton 2002.
2.	Links of E-resources

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations		

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Demonstrate the synthesis of nanoparticles by various techniques.	L2	1	NA
2.	Explain working of basic instruments used in characterization of nanoparticles.	L2	1, 2	NA
3.	Classify the nanomaterials based on the dimensions and applications	L3	2, 5, 12	NA
4.	Assess the suitability of nanomaterials for various device applications	L4	2, 5	NA

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total

4 X 10 marks = 40 marks	60 marks	100 marks

Quiz: 1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test: 1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY**inorder **to secure the certificate.**

Scheme of Test:	
1.	It will be conducted for 60 marks fora maximum of 2 hours duration.
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3.	A. Computer based/ programming courses should have Project based evaluation in Test. Project can done throughout the duration of the course & a presentation/demonstration can be kept at the end for evaluation. B. Theoretical courses can have Descriptive Questions in the Test. C. Other courses which are lab based can have numerical, experiment based questions.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✔														
2	✔	✔													
3		✔			✔							✔			
4		✔			✔										
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Synthesis of Nanoparticles	Battery and sensors industries	R & D Scientist
2	Characterization of Nanoparticles	Analytical Instrumentations	Analyst
3	Development of Solar cells and super capacitors	Energy industries	R & D Scientist

Name & Signature of Faculty members offering the course HOD

Certification Course: Astrophysics

Total Contact Hours	Lecture = 30 Hours Practical = 0 Hours Total = 30 Hours	**CIE Marks**	100
Semester in which the course is offered	5th		

Objectives of the Certification course
1. To learn about observational techniques and instruments. 2. To learn about the birth, evolution and death of stars. 3. To learn about star clusters, galaxies and cosmology.

Pre-requisites :

Topic – I Basics of observations	**Contact Hours = 10 Hours**
The coordinate systems, observational instruments and techniques, photometric concepts, radiation mechanism	

Topic – 2 stars	**Contact Hours = 10 Hours**
Stellar spectrum, stellar structure and evolution, binary stars, compact stars.	

Topic – 3 Beyond stars	**Contact Hours = 10 Hours**
Star cluster, interstellar medium, galaxies, cosmology.	

Reference materials	
1.	H Karttunen et. al, Fundamental Astronomy, Springer, 6th edition/2017
2.	https://ocw.mit.edu/courses/8-282j-introduction-to-astronomy-spring-2006/

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations		

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)			
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**

1.	**Understand the basics of observations in astronomy**	Un	1	
2.	**Describe evolution of a star**	Un	1	
3.	**Understand principles of large- scale structure and cosmology**	Un	1	

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total
4 X 10 marks = 40 marks	60 marks	100 marks

Quiz: 1. Questions can be MCQ type, fill in the blanks, True/False etc 2. Quiz can be conducted during/after the classes.
Eligibility for Test: 1. Minimum of 90% attendance in the classes conducted. 2. Passing the **Test is COMPULSORY** inorder **to secure the certificate.**

Scheme of Test:	
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CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓														
2	✓														
3	✓														
4															
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members offering the course HOD

Certification course Syllabus Template
Financial Management

Total Contact Hours	Lecture = Hours Practical = Hours Total = Hours	**CIE Marks**	100
Semester in which the course is offered	5th Sem		

Objectives of the Certification course
1. The course is designed to inculcate knowledge about investment process and Financial Markets 2. The course is designed to impart the knowledge and thorough understanding of Investment process and knowledge about financial markets 3. The course helps students to develop a thorough, critical understanding of the basic concepts of income tax such as residential status, tax incidence

Pre-requisites: Knowledge of fundamentals of finance, Economics and personal finance

Topic – I	**Contact Hours = 10 Hours**
Theory: **Introduction to Financial Management:** Introduction to Financial Management, Objectives of Financial management- Profit maximization and wealth maximization, Role of a finance manager, Financial management and other functional areas. Sources of financing: shares, debentures, Lease financing, Hybrid financing, Venture capital, Primary market & Secondary market **Practical/demonstration:** Analyzing the present value and future value of cashflows for company's decision making	

Topic – 2	**Contact Hours = 10 Hours**
Theory/Practical/demonstration **Time Value of Money & Cost of Capital**: Present value & future value of single cash flow, Annuity and perpetuity. Simple Interest & Compound interest, Cost of Capital: Cost of equity, preference and debenture capital, Cost of retained earnings. **Practical/demonstration:** Simple Interest & Compound interest	

Topic – 3	**Contact Hours = 10 Hours**
Theory/Practical/demonstration **Investment and Securities Market:** Investment and Speculation, features of a good Investment, Investment Process, Sources of investment information, Introduction to taxation, Deductions available under sec. 80C to 80U. Financial planning: meaning, process and role of	

financial planner Investment Decision Cycle: Judgment under Risk and Uncertainty

Reference materials	
1.	1. Taxman's Students Guide to Income Tax, Basic Personal Taxation. Taxmann Publications Private Limited; Assessment Year 2022-23 edition (24 November 2022); Taxmann Publications Private Limited, 59/32, New Rohtak Road, New Delhi 2. Punithavathy Pandian, Security Analysis and Portfolio Management, Vikas Publications, (2005) 3. Prasanna Chandra, Financial Management,8thEd, TMH 4. I.M .Pandey, Financial Management, 10thEd, Vikas Publishing House
2.	1. Debt & Money Markets: Concepts, Instruments, https://www.edx.org/course/money-debtmarketsconcepts-instruments-risks-and-derivatives 2. Personal Finance, Part 1: Investing in Yourself, https://www.edx.org/course/personal-financepart-1-investing-wellesleyx-pfinan101x0 3. https://swayam.gov.in/courses/277-financial-management

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	Quiz
2.	PPT and Videos	2.	Test- Project /lab based
3.	Practical/programming sessions	3.	Presentation
4.	Demonstrations		

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	To Describe the effects of decision making of finance manager on shareholders wealth maximization	2	1,2	1
2.	To Analyze the role of time value of money and its use for valuing and will be able to calculate cost of capital for the organization	2,3,4	2,6	2
3.	Identify various investment avenues available in the securities market for Investment, and to understand and analyse the various Tax saving options	3	2	3

Scheme of Continuous Internal Evaluation (CIE):

Quiz (4 numbers)	Test (1 Number)	Total
4 X 10 marks = 40 marks	60 marks	100 marks

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CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓												✓		
2		✓				✓								✓	
3		✓													✓
Tick mark the CO, PO and PSO mapping															

Name & Signature of Faculty members offering the course HOD