NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN			
Name of the Programme and Specialization	**M. Tech- INDUSTRIAL AUTOMATION**		
Course Title	**Computer Vision and Image Processing**		
Course Code	**IC 614**	**Course credits**	**3**
Pre-requisites Course Code	**NIL**		
Session	**Jan 2021**	**Section**	**-**
Name of Faculty	**Dr. P.A. Karthick**	**Department**	**ICE**
E-mail	**pakarthick@nitt.edu**	**Mobile No.**	
Course Coordinator(s) (if, applicable)	**NA**	**Telephone No.**	**NA**
Other Course Teacher(s)/Tutor(s) E-mail	**NA**	**Mobile No.**	**NA**
Course Type	☐ **Core course**	■ **Elective course**	

Syllabus (approved in BoS)

Image Formation and Coordinate Transformations, Camera Matrix, Motion/Stereo Pin-hole model, Human eye, cognitive aspects of colour, 3D space; illumination; Sampling and Quantization, Coordinate transformations and camera parameters.

Image Processing - Noise Removal, Blurring, Edge Detection: Canny – Gaussian, Gabor, Texture Edges, Curvature, Corner Detection. Motion Estimation: Horn-Schunk Optical Flow Formulation, Euler-Lagrange formulation: Calculus of variations theory. Structure Recovery from Motion.

Segmentation - Concept of Figure vs. Ground, Watershed, Change Detection, Background Subtraction, Texture Segmentation, Gaussian Mixture Models - Applications in Color and Motion based Image Segmentation, Background Modeling and Shape Clustering.

Machine Learning techniques in Vision, Bayesian Classification, Maximum Likelihood Methods, Neural Networks; Non-parametric models; Manifold estimation, Support Vector Machines; Temporal sequence learning.

Introduction to Object Tracking - Exhaustive vs. Stochastic Search Shapes, Contours, and Appearance Models. Mean-shift tracking; Contour-based models.

Object Modeling and Recognition Fundamental matrix and Epipolar geometry, Adaboost approaches: Face Detection and Recognition, Large Datasets; Attention models.

Applications: Surveillance, Object detection etc.

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COURSE OBJECTIVES

1. To introduce the students to the emerging fields. .
2. To familiarize with both established and emergent methods, algorithms and architectures
3. To enable the students to apply computer vision and image processing techniques to solve various real-world problems, and develop skills for research in the field .
4. To impart practical skills necessary to build computer vision applications .

COURSE OUTCOME (CO)

On completion of this course the students will be able to,

1. understand the major concepts and techniques in computer vision and image processing.
2. demonstrate computer vision and image processing knowledge by designing and implementing algorithms to solve practical problems
3. understand the type of algorithm required for a particular image processing task .
4. implement common methods for robust image matching and alignment.

Course Outcome (CO)	**Aligned Program Outcomes(PO)**
On completion of this course the students will be able to,	
1. understand the major concepts and techniques in computer vision and image processing	1,2
2. demonstrate computer vision and image processing knowledge by designing and implementing algorithms to solve practical problems.	5,6,7
3. understand the type of algorithm required for a particular image processing task.	8,10,11
4. implement common methods for robust image matching and alignment.	13,14

COURSE OVERVIEW

This course introduces fundamental concepts and techniques for image processing and computer vision. This course focuses on studying methods that allow a machine to learn and analyze images and video using geometry and statistical learning. The recent growth of digital imaging technologies, hardware advances, and machine learning models has led to many exciting recent developments in the field of image and video analytics. This course covers a range of topics, starting from the basics of image formation and processing to recent machine learning methods addressing high-level visual recognition problems, such as image segmentation and object detection.

COURSE TEACHING AND LEARNING ACTIVITIES

Sl. No	**Week/Contact Hours**	**Topics**	**Mode of Delivery**
1	1 and 2 (6 Contact hours)	Image Formation and Coordinate Transformations, Camera Matrix, Motion/Stereo Pin-hole model	Through MS Team/ Other applications
2	3 and 4 (6 Contact hours)	Human eye, cognitive aspects of color, 3D space; illumination; Sampling and Quantization, Coordinate transformations and camera parameters.	Through MS Team/ Other applications

3	5 and 6 (6 Contact hours)	Image Processing - Noise Removal, Blurring, Edge Detection: Canny – Gaussian, Gabor, Texture Edges, Curvature, Corner Detection	Through MS Team/ Other applications
4	7 (2 Contact hours)	Motion Estimation: Horn-Schunk Optical Flow Formulation, Euler-Lagrange formulation: Calculus of variations theory	Through MS Team/ Other applications
5	7 (1 Contact hour)	Class Test- 1 : Descriptive Pattern (20% Weightage)	Through MS Team/ Other applications
6	8 (3 Contact hours)	Structure Recovery from Motion, Segmentation - Concept of Figure vs. Ground, Watershed, Change Detection, Background Subtraction, Texture Segmentation	Through MS Team/ Other applications
7	9 (3 Contact hours)	Gaussian Mixture Models - Applications in Color and Motion based Image Segmentation, Background Modeling and Shape Clustering.	Through MS Team online
8	10 (3 Contact hours)	Machine Learning techniques in Vision, Bayesian Classification, Maximum Likelihood Methods	Through MS Team online
9	11 (3 Contact hours)	Neural Networks; Non-parametric models; Manifold estimation, Support Vector Machines; Temporal sequence learning.	Through MS Team online
10	12 (1 Contact hour)	Class Test- 2 : Descriptive Pattern (20% Weightage)	Through MS Team/ Other applications
11	12 (2 Contact hours)	Introduction to Object Tracking - Exhaustive vs. Stochastic Search Shapes, Contours, and Appearance Models. Mean-shift tracking; Contour-based models	Through MS Team/ Other applications
12	13 (3 Contact hours)	Object Modeling and Recognition Fundamental matrix and Epipolar geometry, Adaboost approaches: Face Detection and Recognition, Large Datasets; Attention models.	Through MS Team/ Other applications
13	14 (2 Contact hours)	Applications: Surveillance, Object detection etc.	Through MS Team/ Other applications
14	14 (1 Contact hours)	Doubts clarification & Tutorials	Through MS Team/ Other applications

COURSE ASSESSMENT METHODS

Sl.No.	Mode of Assessment	Week/Date	Duration	Percentage
1	Class Test- 1	7th week	1 hour(online)	20 %
2	Class Test – 2	12th week	1 hour(online)	20 %
3	Compensation exam*		1 hour(online)	20%
4	Assignments and Quiz, and Viva voce	Throughout the course	-	30% (10% each)
5	Final Examination*	End of the semester	2 hours through CBT online	30%

***mandatory; refer to guidelines on page 5 and page 6**

ESSENTIAL READINGS:

Textbooks:

1. D. Forsyth and J. Ponce, Computer Vision: A Modern Approach, 2nd Edition, Prentice Hall 2011.

2. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2011

Reference Books:

1. E.R. Davies, Machine Vision, Theory Algorithms Practicalities, Elsevier, 2005.

2. Richard O. Duda, Peter E. Hart, and David G. Stork, Pattern Classification, 2nd ed., Wiley Asia, 2002.

3. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer; 2011.

4. Simon J.D. Prince, “Computer Vision: Models, Learning, and Interference”, Cambridge University Press, 2012.

5. R. Gonzalez and R. Woods, Digital Image Processing, 3rd Ed, Prentice Hall 2007.

COURSE EXIT SURVEY

1. Anonymous feedback through minute card.

2. Direct feedback from the students by having face-to-face meeting individually / as the class as a whole.

3. Feedback from the students during the class committee meetings

4. Students' performance in the class tests.

COURSE POLICY

MODE OF CORRESPONDENCE (email/ phone, etc.) : Email and Phone

Attendance policy: (A uniform attendance policy as specified below shall be followed)

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.
    - Undergoing internship in foreign countries with prior permission
- Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

Re-test policy

1. Students who have missed the first or second-class test can register for the compensation exam by submitting valid justification in written form.

2. No compensation exam for end semester.

Grading:

1. Relative grading is used to decide the clusters (range) of the total marks scored (class tests, seminar presentation, Assignments/minor project and End Semester Examination put together for each student).

2. The passing minimum is decided based on the institute guidelines.

Re-Assessment Exam

- A student may, for valid reasons on production of valid medical certificate and with the approval of HOD be permitted to withdraw from appearing for the End Semester Examination. Withdrawal application shall be valid only if it is made before the commencement of the examination.
- For students who miss the final Sem Assessment, re-assessment will be conducted for 50% mark and internal marks remain same.
- Those who failed in the subject may register for re-assessment examination, which will be conducted for 100% mark (Absolute grading where passing minimum is 35).
- Grades for the students who have withdrawn from writing the End sem exam will be same as the regular assessment grades. For those who are failed or absent and appearing for reassessment, the maximum grade is restricted to 'E'.
- Re-assessment exam will be conducted in the first week of the next semester or earlier during the vacation.

Formative Assessment (FA):

1. Students who have failed after Re-Assessment Exam of the course will have to register and pass the course by Formative Assessment (FA) only.

Academic honesty & plagiarism:

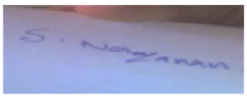
1. Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
2. Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.

3. The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.
4. The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION

The students are advised to clarify their doubts and discuss during the lecture hour. Other than, for out-of-class discussion, they can email their Queries to the Course faculty directly at **pakarthick@nitt.edu**.

FOR APPROVAL



Course Faculty: P. A. Karthick (Dr.P.A.Karthick/ICE)

CC-Chairperson: (Dr. S. Narayanan)

HOD: 08-02-2021 (Dr. G. Uma)