University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering

Course Specification of Medical Image Processing

Course Code (BE453)

I. Course Identification and General Information:

1	**Course Title:**	Medical Image Processing				
2	**Course Code & Number:**	BE453				
3	**Credit hours:**	C.H				TOTAL
		Th.	Seminar	Pr	Tr.	
		2	--	2	--	3
4	**Study level/ semester at which this course is offered:**	5th Level / 1st Semester				
5	**Pre –requisite (if any):**	BE152 (Computer Programming 2) & BE225 (Biomedical Digital Signals Processing)				
6	**Co –requisite (if any):**	None				
7	**Program (s) in which the course is offered:**	Biomedical Engineering Program				
8	**Language of teaching the course:**	English				
9	**Location of Teaching the Course:**	Faculty of Engineering				
10	**Prepared by:**	Assoc. Prof. Dr. Farouk Al-Fahaidy				
11	**Reviewed by:**	Assoc. Prof. Dr. Radwan AL Bouthigy				
12	**Date of Approval:**					

II. Course Description:

This course provides students with fundamentals, concepts and theories related to digital image processing in biomedical imaging systems. Digital image processing (DIP) field has wide range

applications in biomedical devices such as, diseases diagnostics & classification. Course topics include, an introduction to Vision Systems & DIP in biomedical, Image Representation & Processing, image enhancement in spatial & frequency domains, Images Restoration & Segmentation and Image Compression. Throughout Computer-based lab & term-project works, students will verify learned theories and develop their problem-solving skills related to the DIP and the analysis & design of algorithms to meet biomedical imaging systems issues.

III. Course Intended learning outcomes (CILOs) of the course (maximum 8CILOs)		**Referenced PILOs** (Only write code number of referenced Program Intended learning outcomes)
Knowledge and Understanding: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
a1	Understand concepts, fundamentals and theories related to digital image processing in biomedical imaging system.	A1 Describe and explain the underlying mathematical methods and theories; life scientific-principles; and engineering core concepts related to the Biomedical Engineering context.
a2	Explain different DIP methods & techniques such as, trivial images processing, image filtering, image restoration and image segmentation.	A2 Clarify the design principles and techniques and the engineering materials characteristics and how these are relevant to the developments and technologies in a biomedical systems context.
B. Cognitive/ Intellectual Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
b1	Apply well-organized DIP steps to the design and development of DIP software applicable to biomedical imaging field.	B1 Apply engineering principles; basic of life-science; mathematical theories; and modern tools professionally in modelling, analyzing, designing, and constructing physical digital systems; devices and/or processes relevant to

		Biomedical Engineering fields.
b2	Evaluate different filtering, segmentation and restoration techniques & methods, based on their features, capabilities and key-design parameters.	B2 Identify, formulate and solve the complex problems related to the Biomedical Engineering fields in a creative and innovative manner by using a systematic and analytical thinking methods.
C. Professional and Practical Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
c1	Write inventive MATLAB/Python programs for solving biomedical engineering problems related to digital images processing.	C2 Use a wide range of analytical tools, techniques, IT, modern engineering tools, software packages and develop required computer programs to solve, modeling and analyzing Biomedical Engineering problems.
c2	Use MATLAB software and/or Python programming language for modeling & analyzing of DI enhancement, segmentation and restoration algorithms.	C3 Use computational facilities and techniques, measuring instruments, workshops and laboratory equipment to design and conduct experiments, collect, analyse and interpret data and present results in the biomedical systems practice.
D. Transferable Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
d1	Function effectively in performing individual duty & team responsibilities.	D1 Lead and motivate individuals, show capability to work in stressful environments and within constraints, collaborate effectively within multidisciplinary team.
d2	Recognize the influence of DIP science to the biomedical imaging systems & devices used in health	D3 Recognize the needs for, and engage in life-long self-learning.

	diagnosing, when compared to conventional methods.	

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1. Understand concepts, fundamentals and theories related to digital image processing in biomedical imaging system.	• Interactive lectures & examples, • Interactive class discussions, • Exercises and home works.	• Written tests (mid and final terms and quizzes), • Coursework activities assessment, • Home works and assignments.
a2. Explain different DIP methods & techniques such as, trivial images processing, image filtering, image restoration and image segmentation.	• Interactive lectures & examples, • Interactive class discussions, • Exercises and home works.	• Written tests (mid and final terms and quizzes), • Coursework activities assessment, • Home works and assignments.

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1. Apply well-organized DIP steps to the design and development of DIP software	• Interactive lectures & examples, • Interactive class	• Written tests (mid and final terms and quizzes), • Coursework activities

applicable to biomedical imaging field.	discussions, • Exercises and home works,	assessment, • Home works and assignments,
b2. Evaluate different filtering, segmentation and restoration techniques & methods, based on their features, capabilities and key-design parameters.	• Interactive lectures & examples, • Interactive class discussions, • Exercises and home works,	• Written tests (mid and final terms and quizzes), • Coursework activities assessment, • Home works and assignments.

(C) Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1. Write inventive MATLAB/Python programs for solving biomedical engineering problems related to digital images processing.	• Exercises and home works, • Computer laboratory-based sessions, • Directed self- study, • Mini/major project.	• Practical lab performance assessment, • Coursework activities assessment, • Home works and assignments.
c2. Use MATLAB software and/or Python programming language for modeling & analyzing of DI enhancement, segmentation and restoration algorithms.	• Interactive lectures & examples, • Computer laboratory-based sessions, • Mini/major project.	• Practical lab performance assessment, • Coursework activities assessment.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1. Function effectively in performing individual duty & team responsibilities.	• Computer laboratory-based sessions, • Workshops practices, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Mini/major project.	• Lab\Project report • Practical lab performance assessment, • Coursework activities assessment, • Presentations.
d2. Recognize the influence of DIP science to the biomedical imaging systems & devices used in health diagnosing, when compared to conventional methods.	• Computer laboratory-based sessions, • Directed self- study, • Problem based learning, • Mini/major project.	• Short reports, • Lab\Project report • Coursework activities assessment, • Presentations.

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours
1	**Introduction & Course Orientations**	**a1**	– Course Orientations: Course Topics, Aims & Objectives, Tools and Applications, – Machine Vision, Computer Vision, Fields of Computer Vision.	1	2

2	**Introduction to DIP & Medical Images**	**a1, a2**	– Digital Image Processing: Steps, Fundamentals, Image Sampling & Quantization, – Image Representations & Transformations, and DIP System Elements, – Medical Image: Fundamentals, Types, History & Applications.	1	2
3	**Digital Image Acquisition & Basic Operations**	**a1, a2, b1**	– Digital Image Acquisition System, – Basic Image Operations: Image Elements & Basic Operations, Image Pixels, Relationships between Image's Pixels, – Image Pixels & Regions Adjacency, Distances and Paths.	1	2
4	**Image Enhancement**	**a2, b1, b2**	– Spatial Domain Enhancement Methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Filters, Sharpening Filters, – Frequency Domain Enhancement Methods: Fundamentals of Frequency Domain Filtering, Image	3	6

			Smoothing (Low-Pass Filter), Image Sharpening (High-Pass Filter), Selective Filters (Band-Pass/Block Filters).		
5	**Digital Image Programming**	**a2, c2**	– Digital Image Programming: Use of MATLAB and/or Python Programming, Basic DI manipulation Function, Image Representation, Transformation, and Plotting.	1	2
6	**Mid-Term Theoretical Exam**	**a1, a2, b1, b2**	– All Previous Topics	1	2
7	**Image Segmentation**	**a2, b1, b2**	– Introduction to image segmentation, Point, Line and Edge Detection, Region based segmentation., – Classification of segmentation techniques, Region approach to image segmentation, clustering techniques, Image segmentation based on thresholding, Edge based segmentation, Edge detection and linking, Hough transform and Active contour.	2	4
8	**Image**	**a1, a2, b1, b2**	– Introduction to Image	2	2

	Restoration		restoration, Image degradation, Types of image blur, – Classification of image restoration techniques, Image restoration model, Linear and Nonlinear image restoration techniques, and Blind deconvolution.		
9	**Image Registration & Shape Analysis**	**b1, b2**	– Image Registration: Definition, Purpose, bases, Similarity Measures, Optimization & Example, – Shape Analysis: Area, Perimeter, Axes, Aspect Ratio, Compactness, Convexity, Solidity and Fiber Length.	1	2
10	**Image Compression**	**b1, b2**	– Image Compression: Introduction, Need for image compression, Redundancy in images, Classification of redundancy in images, image compression scheme, Classification of image compression schemes, – Fundamentals of information theory, Run	2	4

			length coding, Huffman coding, Arithmetic coding, Predictive coding, Transformed based compression, Image compression standard, – Wavelet-based image compression, JPEG Standards.		
11	**Final Theoretical Exam**	**a1, a2, b1, b2**	ALL Topics	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

B - Practical Aspect: (if any)

Order	Tasks/ Experiments	Number of Weeks	contact hours	Learning Outcomes
1	**Preparing Software Working Environment:** Install either MATLAB of Python Arithmetic and logic Operations: Averaging, Subtraction, Multiplication, Set Operation**.**	**2**	**4**	c2, d1, d2
2	**Intensity Transformation functions:** Image Negatives, Log, Power-Law, Contrast stretching, Intensity-Level Slicing, Bit-Plane Slicing**.**	**2**	**4**	c1, c2, d1
3	**Histogram Processing:** Plotting Image Histogram, Histogram Equalization, Histogram Specification, Local Histogram Processing using statistics.	**1**	**2**	b1, c1, c2, d1
4	**Spatial Filtering:** Smoothing Linear Filters, Order-Static (Nonlinear) Filters, Sharpening Filters.	**3**	**6**	b1, b2, c1, c2, d1

	Frequency Domain Filtering: Low-Pass & High-Pass, Band-Pass & Band-Stop Filters.			
5	**Midterm Practical Exam**	**1**	**2**	c1, c2
6	**Image Segmentation, Demonstration of the Following:** Detection of Isolated Points, Line Detection, Edges detection, Global Thresholding using Iterative Algorithm, Global Thresholding using Iterative Algorithm using Otsu's method, Optimum Global Thresholding Using Otsu's Method, Using Edge to Improve Global Thresholding, Multiple Thresholding, Region Growing, Region Splitting and Merging.	**2**	**4**	b1, b2, c1, c2, d1
7	**Image Restoration:** Image restoration model, Linear and Nonlinear image restoration techniques, and Blind deconvolution	**1**	**2**	b2, c1, c2, d1
8	**Image Registration & Shape Analysis, Image Compressions**	**1**	**2**	c1, c2, d1
9	**Project Presentations** (Students work in teams of 2 or 3 members since the 4th week)	**1**	**2**	a2, b1, b2, c1, c2, d1, d2
10	**Final Practical Exam**	**1**	**2**	c1, c2
Number of Weeks /and Units Per Semester			**15**	**30**

C. Tutorial Aspect:

No.	Tutorial	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	NONE			
Number of Weeks /and Units Per Semester				

V. Teaching Strategies of the Course:

- Interactive lectures & examples,
- Interactive class discussions,
- Exercises and home works,
- Computer laboratory-based sessions,
- Problem based learning,
- Directed self- study,
- Team work (cooperative learning),
- Mini/major project.

VI. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Short reports,
- Practical lab performance assessment,
- Coursework activities assessment,
- Home works and assignments,
- Presentations.

VII. Assignments & Reports:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	**Assignment 1:** Image Processing & Transformations and Basic Image Operations	a1, a2, d1	4th	1
2	**Assignment 2:** Image Enhancement	a1, a2, b2, c2, d1	6th & 7th	1
3	**Assignment 3:** Image Segmentation & Restoration **Short Report:** The Impact of DIP in Biomedical Disease' Diagnostic Devices and New Technologies in the Field.	b1, b2, c1, d1, d2	9th to 12th	3
4	**Assignment 4:** Image Compression	b1, b2, c2, d1	14th	1
5	**Lab Reports**	b1, b2, c1, c2, d1	4th to 12th	4
Total				10

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	**Assignments & Reports**	4th to 14th	10	6.67%	a1, a2, b1, b2, c2, d1, d2
2	**Quizzes**	6th & 12th	10	6.67%	a1, a2, b1, b2
3	**Midterm Theoretical Exam**	8th	20	13.33%	a1, a2, b1, b2,
4	**Midterm Practical Exam**	9th	20	13.33%	b1, b2, c1, c2
5	**Final Practical Exam (including Project Evaluation)**	15th	30	20%	a2, b1, b2, c1, c2, d1, d2

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6	**Final Theoretical Exam**	16th	60	40%	a1, a2, b1, b2
Total			150	100%	

IX. Learning Resources:

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

Example

1- Niku, Saeed B., 2011, **Introduction to Robotics: Analysis, Control, Applications**, 2nd Edition, USA, Wiley.

1- Required Textbook(s) (maximum two).

1- Rafael C. Gonzalez, Richard E. Woods 2017, **Digital Image Processing**, 4th edition, Pearson.

2- Stan Birchfield, 2017, **Image Processing and Analysis**, 1st edition,

2- Essential References.

1. S.Jayaraman, S.Esakkirajan and T.VeeraKumar, 2009, **Digital Image processing**, TataMcGraw Hill publisher.
2. Atam Dhawan, **Medical Image Analysis**, second edition, WILEYISBN: 978-0-470-62205-6.
3. J. Prince and J. Links, **Medical Imaging, Signals and Systems**, ISBN: 0-13-065353-5..
4. Vipula Singh, **Digital Image Processing with MATLAB and Labview**, Elsevier.

3- Electronic Materials and Web Sites *etc*.

Websites:

1- Some Images & Data are taken from:
http://www.mips.stanford.edu/public/video_lectures/index.adp
http://www.math.ucla.edu/~gilboa/PDE-based_image_filtering.html

2- **Some Materials and Data:**
http://www.cs.sunysb.edu/~mueller/

3- Other Web Sources:
Documentation on Matlab and the Image Processing Toolbox can be found on the

	Mathworks' Web site at https://www.mathworks.com/help/

X. Course Policies:

1	**Class Attendance:** A student should attend not less than 75 % of total hours of the subject; otherwise he/she will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring a proof statement from university Clinic. If the absent is more than 25% of a course total contact hours, student will be required to retake the entire course again.
2	**Tardy:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.
3	**Exam Attendance/Punctuality:** A student should attend the exam on time. He/she is permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam
4	**Assignments & Projects**: In general one assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time, mostly one week after given the assignment.
5	**Cheating**: For cheating in exam, a student will be considered as fail. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty.
6	**Plagiarism**: Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proofed a plagiarism of a student, he/she will be

	disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university or according to the university roles.
7	**Other policies**: - Mobile phones are not allowed to use during a class lecture. It must be closed; **otherwise** the student will be asked to leave the lecture room. - Mobile phones are not allowed in class during the examination. - Lecture notes and assignments might be given directly to students using soft or hard copy.

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering

Template for Course Plan (Syllabus)

Medical Image Processing BE453

I. Course Identification and General Information:						
1	**Course Title:**	Medical Image Processing				
2	**Course Code & Number:**	BE453				
3	**Credit Hours:**	**Credit Hours**	**Theory Hours**		**Lab. Hours**	
			Lecture	**Exercise**		
		3	2	--	2	
4	**Study Level/ Semester at which this Course is offered:**	5^{th} Level / 1^{st} Semester				
5	**Pre –Requisite (if any):**	BE152 (Computer Programming 2) & BE225 (Biomedical Digital Signals Processing)				
6	**Co –Requisite (if any):**	None				
7	**Program (s) in which the Course is Offered:**	Bachelor of Biomedical Engineering				
8	**Language of Teaching the Course:**	English				
9	**Location of Teaching the Course:**	Faculty of Engineering				
10	**Prepared by:**	Assoc. Prof. Dr. Farouk Al-Fahaidy				
11	**Reviewed by:**	Assoc. Prof. Dr. Radwan AL Bouthigy				
12	**Date of Approval:**					

II. Course Description:

This course provides students with fundamentals, concepts and theories related to digital image

processing in biomedical imaging systems. Digital image processing (DIP) field has wide range applications in biomedical devices such as, diseases diagnostics & classification. Course topics include, an introduction to Vision Systems & DIP in biomedical, Image Representation & Processing, image enhancement in spatial & frequency domains, Images Restoration & Segmentation and Image Compression. Throughout Computer-based lab & term-project works, students will verify learned theories and develop their problem-solving skills related to the DIP and the analysis & design of algorithms to meet biomedical imaging systems issues.

III. Course Intended Learning Outcomes (CILOs): (مخرجات تعلم المقرر)

A. Knowledge and Understanding: Upon successful completion of the course, students will be able to:	
a1	Understand concepts, fundamentals and theories related to digital image processing in biomedical imaging system.
a2	Explain different DIP methods & techniques such as, trivial images processing, image filtering, image restoration and image segmentation.
B. Intellectual Skills: Upon successful completion of the course, students will be able to:	
b1	Apply well-organized DIP steps to the design and development of DIP software applicable to biomedical imaging field.
b2	Evaluate different filtering, segmentation and restoration techniques & methods, based on their features, capabilities and key-design parameters.
C. Professional and Practical Skills: Upon successful completion of the course, students will be able to:	
c1	Write inventive MATLAB/Python programs for solving biomedical engineering problems related to digital images processing.
c2	Use MATLAB software and/or Python programming language for modeling & analyzing of DI enhancement, segmentation and restoration algorithms.

III. Course Intended Learning Outcomes (CILOs): (مخرجات تعلم المقرر)	
D. Transferable Skills: Upon successful completion of the course, students will be able to:	
d1	Function effectively in performing individual duty & team responsibilities.
d2	Recognize the influence of DIP science to the biomedical imaging systems & devices used in health diagnosing, when compared to conventional methods.

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	**Introduction & Course Orientations**	– Course Orientations: Course Topics, Aims & Objectives, Tools and Applications, – Machine Vision, Computer Vision, Fields of Computer Vision.	1	2
2	**Introduction to DIP & Medical Images**	– Digital Image Processing: Steps, Fundamentals, Image Sampling & Quantization, – Image Representations & Transformations, and DIP System Elements, – Medical Image: Fundamentals, Types, History & Applications.	1	2
3	**Digital Image Acquisition & Basic Operations**	– Digital Image Acquisition System, – Basic Image Operations: Image Elements & Basic Operations, Image Pixels, Relationships	1	2

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		between Image's Pixels, – Image Pixels & Regions Adjacency, Distances and Paths.		
4	**Image Enhancement**	– Spatial Domain Enhancement Methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Filters, Sharpening Filters, – Frequency Domain Enhancement Methods: Fundamentals of Frequency Domain Filtering, Image Smoothing (Low-Pass Filter), Image Sharpening (High-Pass Filter), Selective Filters (Band-Pass/Block Filters).	3	6
5	**Digital Image Programming**	– Digital Image Programming: Use of MATLAB and/or Python Programming, Basic DI manipulation Function, Image Representation, Transformation, and Plotting.	1	2
6	**Mid-Term Theoretical Exam**	– All Previous Topics	1	2
7	**Image Segmentation**	– Introduction to image segmentation, Point, Line and Edge Detection, Region based segmentation.,	2	4

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		– Classification of segmentation techniques, Region approach to image segmentation, clustering techniques, Image segmentation based on thresholding, Edge based segmentation, Edge detection and linking, Hough transform and Active contour.		
8	**Image Restoration**	– Introduction to Image restoration, Image degradation, Types of image blur, – Classification of image restoration techniques, Image restoration model, Linear and Nonlinear image restoration techniques, and Blind deconvolution.	2	2
9	**Image Registration & Shape Analysis**	– Image Registration: Definition, Purpose, bases, Similarity Measures, Optimization & Example, – Shape Analysis: Area, Perimeter, Axes, Aspect Ratio, Compactness, Convexity, Solidity and Fiber Length.	1	2
10	**Image Compression**	– Image Compression: Introduction, Need for image compression, Redundancy in images,	2	4

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		Classification of redundancy in images, image compression scheme, Classification of image compression schemes, – Fundamentals of information theory, Run length coding, Huffman coding, Arithmetic coding, Predictive coding, Transformed based compression, Image compression standard, – Wavelet-based image compression, JPEG Standards.		
11	**Final Theoretical Exam**	ALL Topics	1	2
Number of Weeks /and Units Per Semester			**16**	**32**

B. Case Studies and Practical Aspect:

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	**Preparing Software Working Environment:** Install either MATLAB of Python Arithmetic and logic Operations: Averaging, Subtraction, Multiplication, Set Operation**.**	**2**	**4**
2	**Intensity Transformation functions:** Image Negatives, Log, Power-Law, Contrast stretching, Intensity-Level Slicing, Bit-Plane Slicing**.**	**2**	**4**

B. Case Studies and Practical Aspect:			
No.	**Tasks/ Experiments**	**Number of Weeks**	**Contact Hours**
3	**Histogram Processing:** Plotting Image Histogram, Histogram Equalization, Histogram Specification, Local Histogram Processing using statistics.	**1**	**2**
4	**Spatial Filtering:** Smoothing Linear Filters, Order-Static (Nonlinear) Filters, Sharpening Filters. **Frequency Domain Filtering:** Low-Pass & High-Pass, Band-Pass & Band-Stop Filters.	**3**	**6**
5	**Midterm Practical Exam**	**1**	**2**
6	**Image Segmentation, Demonstration of the Following:** Detection of Isolated Points, Line Detection, Edges detection, Global Thresholding using Iterative Algorithm, Global Thresholding using Iterative Algorithm using Otsu's method, Optimum Global Thresholding Using Otsu's Method, Using Edge to Improve Global Thresholding, Multiple Thresholding, Region Growing, Region Splitting and Merging.	**2**	**4**
7	**Image Restoration:** Image restoration model, Linear and Nonlinear image restoration techniques, and Blind deconvolution	**1**	**2**
8	**Image Registration & Shape Analysis,** **Image Compressions**	**1**	**2**
9	**Project Presentations** (Students work in teams of 2 or 3 members since the 4th week)	**1**	**2**

B. Case Studies and Practical Aspect:			
No.	**Tasks/ Experiments**	**Number of Weeks**	**Contact Hours**
10	**Final Practical Exam**	**1**	**2**
Number of Weeks /and Units Per Semester		**15**	**30**

C. Tutorial Aspect:			
No.	**Tutorial**	**Number of Weeks**	**Contact Hours**
1	NONE		
Number of Weeks /and Units Per Semester			

V. Teaching Strategies of the Course:

- Interactive lectures & examples,
- Interactive class discussions,
- Exercises and home works,
- Computer laboratory-based sessions,
- Problem based learning,
- Directed self- study,
- Team work (cooperative learning),
- Mini/major project.

VI. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Short reports,
- Practical lab performance assessment,

VI. Assessment Methods of the Course:

- Coursework activities assessment,
- Home works and assignments,
- Presentations.

VII. Assignments & Reports:

No.	Assignments	Week Due	Mark
1	**Assignment 1:** Image Processing & Transformations and Basic Image Operations	4th	1
2	**Assignment 2:** Image Enhancement	6th & 7th	1
3	**Assignment 3:** Image Segmentation & Restoration **Short Report:** The Impact of DIP in Biomedical Disease' Diagnostic Devices and New Technologies in the Field.	9th to 12th	3
4	**Assignment 4:** Image Compression	14th	1
5	**Lab Reports**	4th to 12th	4
Total			

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1	**Assignments & Reports**	4th to 14th	10	6.67%

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VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
2	**Quizzes**	6th & 12th	10	6.67%
3	**Midterm Theoretical Exam**	8th	20	13.33%
4	**Midterm Practical Exam**	9th	20	13.33%
5	**Final Practical Exam (including Project Evaluation)**	15th	30	20%
6	**Final Theoretical Exam**	16th	60	40%
Total			**150**	**100%**

IX. Learning Resources:

- *Written in the following order:*

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

Example

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1- Required Textbook(s) (maximum two):

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2- Stan Birchfield, 2017, **Image Processing and Analysis**, 1st edition.

2- Essential References:

1- S.Jayaraman, S.Esakkirajan and T.VeeraKumar, 2009, **Digital Image processing**, TataMcGraw Hill publisher.

2- Atam Dhawan, **Medical Image Analysis**, second edition, WILEYISBN: 978-0-470-62205-6.

IX. Learning Resources:

3- J. Prince and J. Links, **Medical Imaging, Signals and Systems**, ISBN: 0-13-065353-5..

4- Vipula Singh, **Digital Image Processing with MATLAB and Labview**, Elsevier.

3- Electronic Materials and Web Sites etc.:

Websites:

1- Some Images & Data are taken from:
http://www.mips.stanford.edu/public/video_lectures/index.adp

http://www.math.ucla.edu/~gilboa/PDE-based_image_filtering.html

2- **Some Materials and Data:**

http://www.cs.sunysb.edu/~mueller/

3- Other Web Sources:

Documentation on Matlab and the Image Processing Toolbox can be found on the Mathworks' Web site at https://www.mathworks.com/help/

X. Course Policies:

1	**Class Attendance:** A student should attend not less than 75 % of total hours of the subject; otherwise he/she will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring a proof statement from university Clinic. If the absent is more than 25% of a course total contact hours, student will be required to retake the entire course again.
2	**Tardy:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.
3	**Exam Attendance/Punctuality:** A student should attend the exam on time. He/she is permitted to attend an exam half one hour

	from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam
4	**Assignments & Projects**: In general one assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time, mostly one week after given the assignment.
5	**Cheating**: For cheating in exam, a student will be considered as fail. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty.
6	**Plagiarism**: Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proofed a plagiarism of a student, he/she will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university or according to the university roles.
7	**Other policies**: - Mobile phones are not allowed to use during a class lecture. It must be closed; **otherwise** the student will be asked to leave the lecture room. - Mobile phones are not allowed in class during the examination. - Lecture notes and assignments might be given directly to students using soft or hard copy.