

#### Name of Institute: Institute of Technology & Engineering Name of Faculty: Dr. Vrushank Shah

### Course code: EC0729

#### **Course name: Pattern Recognition Techniques**

Pre-requisites: Machine Learning Credit points: 3 Offered Semester: 7th

#### Course coordinator (weeks 01 - 14)

Full name: Dr. Vrushank Shah Department with siting location: Electronics & Communication Engineering Telephone: 9898331721

Email: vrushankshah.ec@indusuni.ac.in Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

#### **Course lecturer (weeks 01 - 14)**

Full name: Dr. Vrushank Shah Department with siting location: Electronics & Communication Engineering Telephone: 9898331721

Email: vrushankshah.ec@indusuni.ac.in Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

Students will be contacted throughout the session via mail with important information relating to this course.

#### **Course Objectives**

- 1. To equip students with basic mathematical and statistical techniques commonly used in pattern recognition.
- 2. To introduce students to a variety of pattern recognition algorithms.
- 3. Enable students to apply machine learning concepts in real life problems.

#### **Course Outcomes (CO)**

After successful completion of this course, student will be able to

1. Understand machine learning concepts and range of problems that can be handled by machine learning.

- 2. Compare and parameterize different learning algorithms.
- 3. Apply the machine learning concepts in real life problems.
- 4. Bring out structural pattern recognition and feature extraction techniques
- 5. Identify, analyze, formulate, and solve engineering problems
- 6. Realize the clustering concepts and algorithms



#### **Course Outline**

| Unit<br>No.          | Topics  |  |  |  |  |  |  |
|----------------------|---|--|--|--|--|--|--|
| 1                    | I ntroduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis   |  |  |  |  |  |  |
|                      | Linear models: Linear Models for Regression, linear regression, logistic regression Linear<br>Models for Classification   |  |  |  |  |  |  |
| 2                    | N eural N etwork: perceptron, multi-layer perceptron, backpropagation algorithm, error surfaces, practical techniques for improving backpropagation, additional networks and training methods, Adaboost, Deep Learning  |  |  |  |  |  |  |
| 3                    | Linear discriminant functions - decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine   |  |  |  |  |  |  |
| 4                    | Algorithm independent machine learning – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering, hierarchical clustering   |  |  |  |  |  |  |
| Text<br>books        | Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2/E, Wiley -<br>nterscience, 2000.  |  |  |  |  |  |  |
| Refere<br>Books<br>s | <ul> <li>Christopher M. Bishop :, "Pattern Recognition And Machine Learning<br/>(I nformation Science and Statistics)", 1/E, Springer, January 2008</li> <li>Hastie, R. Tibshirani, J. H. Friedman:, "The Elements of Statistical<br/>Learning", 1/E, Springer, Reprint 3/E, 2003</li> <li>Christopher M. Bishop ; "Pattern Recognition and Machine Learning", Springer,<br/>2006</li> <li>Shigeo Abe, "Advances in Pattern Recognition", Springer, 2005</li> </ul> |  |  |  |  |  |  |

#### **Method of delivery**

- 1. Chalk and talk
- 2. PowerPoint Presentations
- 3. Self-study material
- 4. NPTEL notes



#### **Study time**

3 hours per week Lectures

|     | PO<br>1      | P<br>0<br>2  | РО<br>3      | РО<br>4 | РО<br>5      | РО<br>6 | РО<br>7 | РО<br>8 | РО<br>9      | PO1<br>0 | PO1<br>1     | PO1<br>2 |
|-----|--------------|--------------|--------------|---------|--------------|---------|---------|---------|--------------|----------|--------------|----------|
| C01 | $\checkmark$ | $\checkmark$ | $\checkmark$ |         | $\checkmark$ |         |         |         | $\checkmark$ |          |              |          |
| CO2 | $\checkmark$ | $\checkmark$ | $\checkmark$ |         | $\checkmark$ |         |         |         | $\checkmark$ |          |              |          |
| CO3 | $\checkmark$ |              |              |         | $\checkmark$ |         |         |         | $\checkmark$ |          |              |          |
| CO4 | $\checkmark$ |              |              |         | $\checkmark$ |         |         |         | $\checkmark$ |          | $\checkmark$ |          |
| CO5 | $\checkmark$ |              | $\checkmark$ |         | $\checkmark$ |         |         |         |              |          | $\checkmark$ |          |
| CO6 |              |              |              |         |              |         |         |         |              |          |              |          |

#### **CO-PO Mapping (PO: Program Outcomes)**

#### **Blooms Taxonomy and Knowledge retention (For reference)** (Blooms taxonomy has been given for reference)





## **Graduate Qualities and Capabilities covered** (Qualities graduates harness crediting this Course)

| General Graduate Qualities   | Specific Department of                                |
|--|---|
| Informed<br>Have a sound knowledge of an area<br>of study or profession and<br>understand its current issues, locally<br>and internationally. Know how to<br>apply this knowledge. Understand<br>how an area of study has developed<br>and how it relates to other areas.  | 1 Professional knowledge,<br>grounding & awareness    |
| Independent learners<br>Engage with new ideas and ways of<br>thinking and critically analyze<br>issues. Seek to extend knowledge<br>through ongoing research, enquiry<br>and reflection. Find and evaluate<br>information, using a variety of<br>sources and technologies.<br>Acknowledge the work and ideas of<br>others. | 2 Information literacy, gathering<br>& processing     |
| <b>Problem solvers</b><br>Take on challenges and<br>opportunities. Apply creative, logical<br>and critical thinking skills to respond<br>effectively. Make and implement<br>decisions. Be flexible, thorough,<br>innovative and aim for high<br>standards.   | 4 Problem solving skills                              |
| Effective communicators  | 5 Written communication                               |
| Articulate ideas and convey them<br>effectively using a range of media.<br>Work collaboratively and engage   | 6 Oral communication<br>7 Teamwork                    |
| with people in different settings.<br>Recognize how culture can shape<br>communication.  |   |
| <b>Responsible</b><br>Understand how decisions can affect<br>others and make ethically informed<br>choices. Appreciate and respect<br>diversity. Act with integrity as part<br>of local, national, global and<br>professional communities.   | 10 Sustainability, societal &<br>environmental impact |



#### **Practical work : Not Applicable**

#### Lecture/tutorial times

(Give lecture times in the format below)

Tuesday-12.20 to 1.20 PM Thrusday: 9:00 to 10.00 PM Friday: 2:20 to 3:20

#### **Details of referencing system to be used in written work**

- 1. Text Books and Reference Books
- 2. Online Resources

#### **Text books**

Mention in syllabus

#### **Additional Materials**

#### **ASSESSMENT GUIDELINES**

Your final course mark will be calculated from the following:

- 1. Theory CIE 60 marks:
- a. Midsem exam: 40 Marks
- b. Assignment: 10 Marks
- c. Quiz: 10 Marks
- 2. Practical CIE 60 marks:
- a. Experiment Performance 30 Marks
- b. File work + Skill Test 20 Marks
- c. Internal Viva 10 Marks

#### SUPPLEMENTARY ASSESSMENT



Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

#### Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

#### Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 10 % of the maximum mark per calendar day

#### Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.

#### **Retention of Written Work**

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

#### **University and Faculty Policies**

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

**Plagiarism** - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

#### Do not copy the work of other students.

Do not share your work with other students (except where required for a group activity or assessment)



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# **Course schedule (subject to change)** (Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

|  | Week #  | Topic & contents   | CO<br>Addressed | Teaching<br>Learning<br>Activity<br>(TLA)        |
|--|---------|--|-----------------|--|
|  | Weeks 1 | I ntroduction to Pattern Recognition:<br>Problems, applications, design cycle,<br>learning and adaptation, examples, | CO1 CO3         | Chalk and<br>talk<br>PowerPoint<br>Presentations |
|  | Weeks 2 | Probability Distributions, Parametric<br>Learning - Maximum likelihood   | CO1 CO3         | Chalk and<br>talk<br>PowerPoint<br>Presentations |
|  | Week 3  | Bayesian Decision Theory- Bayes rule,<br>discriminant functions, loss functions<br>and Bayesian error analysis       | CO1 CO3         | Chalk and<br>talk<br>PowerPoint<br>Presentations |
|  | Week 4  | Linear models: Linear Models for<br>Regression, 1  | CO1 CO3         | Chalk and<br>talk<br>PowerPoint<br>Presentations |
|  | Week 5  | linear regression, logistic regression<br>Linear Models for Classification   | CO2 CO3         | Chalk and<br>talk<br>PowerPoint<br>Presentations |
|  |         |  |                 |  |
|  | Week 6  | N eural N etwork: perceptron, multi-<br>layer perceptron   | CO2 CO3         | Chalk and<br>talk<br>PowerPoint<br>Presentations |
|  | Week 7  | backpropagation algorithm, error surfaces  | CO2 CO3<br>CO5  | Chalk and<br>talk<br>PowerPoint<br>Presentations |
|  | Week 8  | practical techniques for improving backpropagation   | CO2 CO3         | Chalk and<br>talk<br>PowerPoint<br>Presentations |
|  | Week 9  | additional networks and training methods   | CO2 CO3         | Chalk and<br>talk<br>PowerPoint<br>Presentations |

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|---------|---|---------|--|
| Week 10 | Adaboost, Deep Learning   | CO2 CO5 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 11 | Linear discriminant functions - decision surfaces   | CO4 CO5 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 12 | two-category, multi-category, minimum<br>squared error procedures, the Ho-<br>Kashyap procedures<br>linear programming algorithms, Support<br>vector machine                      | CO4 CO5 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 13 | Algorithm independent machine<br>learning – lack of inherent superiority of<br>any classifier, bias and variance, re-<br>sampling for classifier design,<br>combining classifiers | C05     | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 14 | Unsupervised learning and clustering –<br>k-means clustering, fuzzy k-means<br>clustering, hierarchical clustering  | C05     | Chalk and<br>talk<br>PowerPoint<br>Presentations |



**Program map for B.Tech (Electronics & Communication Engineering)** 



![](_page_9_Picture_0.jpeg)

#### Name of Institute: Indus Institute of Technology and Engineering (IITE) Name of Faculty: Divyangna Gandhi

#### Course code: EC0718 Course name: Biomedical Instrumentation and Imaging

Pre-requisites: Knowledge of basic electronics principles, sensor/ transducers, op-amp based circuit, simulation, Matlab software

Credit points: 04 Offered Semester: 7<sup>th</sup>

#### **Course Coordinator (weeks 15)**

Full Name: Divyangna Gandhi Department with sitting location: 2<sup>nd</sup> Floor, Bhanwar Building, EC Lab 5(Digital and Networking Lab), IITE - IU

Telephone: 3202 Email: <u>Divyangnagandhi.ec@indusuni.ac.in</u> Consultation times: 4:00PM to 4:45PM

#### **Course Lecturer (weeks 15)**

Full Name: Divyangna Gandhi Department with sitting location: 2<sup>nd</sup> Floor, Bhanwar Building, EC Lab 5(Digital and Networking Lab), IITE - IU

Telephone: 3202 Email: <u>Divyangnagandhi.ec@indusuni.ac.in</u> Consultation times: 4:00PM to 4:45PM

Students will be contacted throughout the session via mail with important information relating to this course.

#### **Course Objectives**

By participating in and understanding all facets of this course a student will:

- To introduce student to basic biomedical engineering & Imaging technology
- To introduce different biological signals, their acquisition, measurements and related constraints
- To understand patient monitoring system and preliminary diagnostic tools for patient health condition.
- To understand basic principles and phenomena in the area of medical diagnostic & imaging instrumentation
- Theoretical and practical preparation for enabling students to maintain medical instrumentation

![](_page_10_Picture_0.jpeg)

• To understand the recent trends in medical instrumentation

#### **Course Outcomes (CO)**

1 Understand medical terminology & origin of Bio potentials relevant to biomedical instrumentation

- 2. Understand measurement, display and analysis of various bio signals
- 3. Understand different medical imaging systems for different diagnoses

4. Know about Endoscopy unit, Laser in medicine and Electrical safety in medical equipment

5. Design project for biomedical application of electronics

6. Design electronic instruments for measurement of vital sign medical parameters and Implement the electric safety of the medical instruments

#### **Course Outline**

Basic Electronics Sensor/ transducers Op-amp based circuit

#### **Method of delivery**

(Online lectures, self-study material, Active Learning Techniques)

#### **Study time**

(3 Hour's theory and 2 Hour's Lab per week)

#### **CO-PO Mapping (PO: Program Outcomes)**

| ро | РО |   |   |   |   |   |   |   |   |    |    |    |
|----|----|---|---|---|---|---|---|---|---|----|----|----|
| со | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1  |    |   |   |   |   |   |   |   |   |    |    |    |
| 2  |    |   |   |   |   |   |   |   |   |    |    |    |
| 3  |    |   |   |   |   |   |   |   |   |    |    |    |
| 4  |    |   |   |   |   |   |   |   |   |    |    |    |
| 5  |    |   |   |   |   |   |   |   |   |    |    |    |
| 6  |    |   |   |   |   |   |   |   |   |    |    |    |

![](_page_11_Picture_0.jpeg)

#### Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

![](_page_11_Figure_3.jpeg)

#### Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

![](_page_12_Picture_0.jpeg)

| General Graduate Qualities   | Specific Department ofGraduate Capabilities        |
|--|--|
| <b>Informed</b><br>Have a sound knowledge of an area of study<br>or profession and understand its current<br>issues, locally and internationally. Know how<br>to apply this knowledge. Understand how an<br>area of study has developed and how it relates<br>to other areas.  | 1 Professional knowledge, grounding &<br>awareness |
| <b>Independent learners</b><br>Engage with new ideas and ways of thinking<br>and critically analyze issues. Seek to extend<br>knowledge through ongoing research, enquiry<br>and reflection. Find and evaluate information,<br>using a variety of sources and technologies.<br>Acknowledge the work and ideas of others. | 2 Information literacy, gathering & processing     |
| <b>Problem solvers</b><br>Take on challenges and opportunities. Apply<br>creative, logical and critical thinking skills to<br>respond effectively. Make and implement<br>decisions. Be flexible, thorough, innovative<br>and aim for high standards.   | 4 Problem solving skills                           |
| Effective communicators  | 5 Written communication                            |
| Articulate ideas and convey them effectively<br>using a range of media. Work collaboratively<br>and engage with people in different settings.<br>Recognize how culture can shape<br>communication.   | 6 Oral communication<br>7 Teamwork                 |
| Responsible  | 10 Sustainability, societal & environmental        |
| Understand how decisions can affect others<br>and make ethically informed choices.<br>Appreciate and respect diversity. Act with<br>integrity as part of local, national, global and<br>professional communities.  | impact   |

#### Lecture/tutorial times

| Example: |           |                  |                         |
|----------|-----------|------------------|-------------------------|
| Lecture  | Monday    | 09.00 -10.00PM   | Online                  |
| Lecture  | Thursday  | 03.10 - 04.10PM  | Online                  |
| Lecture  | Friday    | 11:10 - 12.10 AM | Online                  |
| Lab      | Wednesday | 02:00 to 04:10   | Online/Industrial visit |
|          |           |                  |                         |

#### **Attendance Requirements**

![](_page_13_Picture_0.jpeg)

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

#### Details of referencing system to be used in written work

#### Text books

| Text<br>books      | R.S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill Publication.   |  |  |  |
|--------------------|--|--|--|--|
|                    | Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical<br>Instrumentation and Measurement", Prentice Hall India Pvt. Ltd., New<br>Delhi, 2nd Edition, Reprint, 2013.   |  |  |  |
| Reference<br>Books | <ul><li>L.A Geddes and L.E.Baker, "Principles of Applied Biomedical<br/>Instrumentation" Third Edition, John Wiley and sons, Reprint<br/>2008.</li><li>Carr &amp; Brown, Introduction to biomedical equipment<br/>technology, Prentice Hall Publication.</li></ul> |  |  |  |
|                    | Khandpur R.S, "Handbook of Biomedical Instrumentation",<br>Tata McGraw Hill, New Delhi, 3 <sup>rd</sup> Edition, 2014.   |  |  |  |

#### **Additional Materials**

- 2. https://nptel.ac.in/courses/117108037/15
- 3. http://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering
- 4. https://lecturenotes.in/subject/27/biomedical-instrumentation-bi

#### **ASSESSMENT GUIDELINES**

Your final course mark will be calculated from the following:

| Example:          |              |                  |  |  |  |  |  |
|-------------------|--------------|------------------|--|--|--|--|--|
| Midterm Exam      | 40%          | Objective (1-6)  |  |  |  |  |  |
| Presentation      | 5%           | Objectives (2-5) |  |  |  |  |  |
| Attendance        | 5%           |                  |  |  |  |  |  |
| Assignment        | 10%          | Objectives (2-5) |  |  |  |  |  |
| Final exam (close | ed book) 40% | Objectives (1-6) |  |  |  |  |  |

![](_page_14_Picture_0.jpeg)

#### SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

#### Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

#### Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.

#### **Retention of Written Work**

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

#### **University and Faculty Policies**

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

**Plagiarism** - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

#### Do not copy the work of other students.

Do not share your work with other students (except where required for a group activity or assessment)

![](_page_15_Picture_0.jpeg)

#### **Course schedule**

|  | Week 15 | Topic & contents   | CO Addressed | Teaching<br>Learning<br>Activity (TLA) |
|--|---------|--|--------------|--|
|  | Weeks 1 | To aware students with theoretical and<br>practical syllabus, assessment scheme<br>for theory (CIE, End sem exam),<br>practical (CIE, End sem exam) and all<br>the details about subject activities has to<br>be carry out throughout the semester<br>Fundamental of Biomedical<br>Instrumentation, Sources of Biomedical<br>signals | 1            | BB,PPT                                 |
|  | Weeks 2 | General constraints in designing of<br>medical instrumentation systems,<br>Generalized medical instrumentation<br>block diagram  | BB,PPT       |  |
|  | Week 3  | Origin of bioelectric signals: ECG,<br>EEG, EMG, Classification of Medical<br>instruments.   | 1,2,3        | BB,PPT                                 |
|  | Week 4  | The Transducers & Transduction<br>principles, Active transducers, Passive<br>Transducers, Transducer for Biomedical<br>Applications  | 1,2,3        | BB,PPT                                 |
|  | Week 5  | Electrode theory, electrode behavior and<br>circuit model of Electrode, Types of<br>Electrode, Electrode for Biomedical<br>Applications  | 1,5          | BB,PPT                                 |
|  | Week 6  | Electrocardiograph(ECG) machine<br>,ECG block diagram ,Bipolar and<br>unipolar leads ,Phonocardiograph   | 1,5          | BB,PPT                                 |
|  | Week 7  | Electroencephalograph (EEG),10-20<br>electrode placement system ,EEG<br>readout device , Electromyograph<br>(EMG) machine, Bio-feedback<br>Instrumentation   | 3,4,         | BB,PPT                                 |
|  | Week 8  | Measurement of heart rate, blood<br>pressure measurement, blood flow<br>meter, blood gas analyzer,<br>electromagnetic blood flow meter   | 1,2,3        | BB,PPT                                 |

![](_page_16_Picture_0.jpeg)

| Week 9  | Ultrasonic blood flow meter, NMR blood flow meter, blood gas analyzer.                                  | 3,4   | BB,PPT |
|---------|---|-------|--------|
| Week 10 | X-ray machine, CT-Scan machine, MRI<br>machine , Properties of ultrasound<br>,Ultrasonic fetal monitors | 3,4,5 | BB,PPT |
| Week 11 | Echoencephalography,<br>Echo-cardiograph., Colour Doppler<br>ultrasound machine                         | 3,4,5 | BB,PPT |
| Week 12 | Thermograph, endoscopy unit, Laser in<br>medicine, Diathermy units, Cardiac<br>Pacemaker                | 3.4   | BB,PPT |
| Week 13 | Physiological effects of electricity,<br>important susceptibility parameters                            | 5,6   | BB,PPT |
| Week 14 | Macro shock hazards, micro shock<br>hazards, and basic approaches to<br>protection against shock        | 5,6   | BB,PPT |
| Week 15 | Revision  |       | BB,PPT |

![](_page_17_Picture_0.jpeg)

![](_page_17_Figure_1.jpeg)

![](_page_18_Picture_0.jpeg)

#### Name of Institute: Institute of Technology and Engineering Name of Faculty: Asst. Prof Miloni Ganatra

#### Course code: EC0719 Course name: Embedded Systems Pre-requisites: Microprocessor,DSP,Microcontroller and Interfacing Credit points: 4

Offered Semester: VII

#### **Course Coordinator (weeks 12)**

Full Name: Miloni Ganatra Department with sitting location: 2<sup>nd</sup> Floor, EEE lab 2 , Bhanwar Building Telephone: 9974592124 Email: miloniganatra.ee@indusuni.ac.in Consultation times: Monday,Tuesday 3:45 to 4:15pm ,All working Saturdays

#### **Course Lecturer (weeks 12)**

Full Name: Miloni Ganatra Department with siting location: 2<sup>nd</sup> Floor, EEE lab 2 , Bhanwar Building Telephone: 9974592124 Email: miloniganatra.ee@indusuni.ac.in Consultation times: Monday,Tuesday 3:45 to 4:15pm,All working Saturdays

Students will be contacted throughout the session via mail with important information relating to this course.

EC0719, Semester:VII (2021)

![](_page_19_Picture_0.jpeg)

#### **Course Objectives**

By participating in and understanding all facets of this course a student will:

- 1) To Introduce students to the Embedded system components.
- 2) To Understand the embedded system design constraint.
- 3) To introduce students to the ARM architecture and its programming.
- 4) To introduce students to the Real Time Operating System.
- 5) To introduce students to the Inter-process communication methods.

#### **Course Outcomes (CO)**

- 1) Define and explain embedded systems and the different embedded system design technologies explain the various metrics or challenges in designing an embedded system.
- 2) Discuss about optimizing single purpose processors. Discuss about the basic architecture and operation of general-purpose processors.
- 3) Explain about the basics of interrupts. Explain the different architectures like Round Robin. Describe the Real Time Operating System architecture.
- 4) Express tasks and states. Explain semaphores. Clarify about message queues, mailboxes, and pipes. Describe the process of effective memory management.
- 5) Explain encapsulating semaphores and queues. Discuss the considerations in hard real time scheduling. Delve into hardware software co design aspects in embedded systems.

#### **Course Outline**

#### UNIT -1

#### Introduction

Embedded system and general purpose computers, Embedded system components, Embedded System Design Process Classification of an embedded system, Examples of an embedded system Applications of an embedded system.

#### ARM Architecture

ARM Programming Model, Processor Modes, Registers, Exceptions, Interrupts & the vector table, Pipeline, 3-stage Pipeline ARM Organization, 5-stage Pipeline ARM Organization

![](_page_20_Picture_0.jpeg)

#### UNIT-2

#### ARM Instruction set

Data Processing Instructions, Branch Instructions, Load-Store Instructions, Software-Interrupt Instruction, Program status register instruction, Multiply instruction, Assembly language Programs

#### Thumb Instruction set

Thumb programmers model, Thumb branch instruction, Thumb software interrupt instruction, Thumb data process instruction, Thumb single register data transfer instruction, Thumb multiple register data transfer instruction, Thumb breakpoint instruction

#### UNIT-3

#### Interprocess communication and synchronization

Multiple process & thread in application, Task and task state, Task control block ,Task coding, Task scheduling, Semaphores for synchronization, Data sharing & deadlocks, Interprocess Communication

RTOS

UNIT-4

![](_page_21_Picture_0.jpeg)

Operating system services, Process management, Timer & Event function, Memory management, Device, file, I/O subsystem management, Interrupt routine in RTOS environment and handling of interrupt service calls, Basic design using RTOS, RTOS task scheduling models, Interrupt latency and response of task & performance metrics, OS security issues

#### Method of delivery

(lectures, PPT, Chalkboard)

#### Study time

3 Hour's theory and 2 Hour's Practical session per week

#### **CO-PO Mapping (PO: Program Outcomes)**

#### Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

| PO | РО  |              |   |   |   |   |   |   |   |    |    |    |
|----|-----|--------------|---|---|---|---|---|---|---|----|----|----|
|    | · 1 | 2            | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1  |     |              |   |   |   |   |   |   |   |    |    |    |
| 2  |     |              |   |   |   |   |   |   |   |    |    |    |
| 3  |     | $\checkmark$ |   |   |   |   |   |   |   |    |    |    |
| 4  |     | $\checkmark$ |   |   |   |   |   |   |   |    |    |    |
| 5  |     |              |   | V |   |   |   |   |   |    |    |    |

![](_page_22_Picture_0.jpeg)

![](_page_22_Figure_1.jpeg)

Figure 2: Knowledge retention

#### **Graduate Qualities and Capabilities covered**

(Qualities graduates harness crediting this Course)

| General Graduate Qualities   | Specific Department of Electronics and<br>Communication Engineering Graduate<br>Capabilities |
|--|--|
| Informed<br>Have a sound knowledge of an area of<br>study or profession and understand its<br>current issues, locally and internationally.<br>Know how to apply this knowledge.<br>Understand how an area of study has | 1 Professional knowledge, grounding & awareness  |

![](_page_23_Picture_0.jpeg)

| developed and how it relates to other areas.  |  |
|---|--|
| Independent learners<br>Engage with new ideas and ways of<br>thinking and critically analyze issues.<br>Seek to extend knowledge through<br>ongoing research, enquiry and reflection.<br>Find and evaluate information, using a<br>variety of sources and technologies.<br>Acknowledge the work and ideas of<br>others. | 2 Information literacy, gathering & processing     |
| Problem solvers<br>Take on challenges and opportunities.<br>Apply creative, logical and critical thinking<br>skills to respond effectively. Make and<br>implement decisions. Be flexible,<br>thorough, innovative and aim for high<br>standards.  | 4 Problem solving skills                           |
| Effective communicators   | 5 Written communication                            |
| Articulate ideas and convey them<br>effectively using a range of media. Work<br>collaboratively and engage with people in<br>different settings. Recognize how culture<br>can shape communication.  | 6 Oral communication<br>7 Teamwork                 |
| <b>Responsible</b><br>Understand how decisions can affect<br>others and make ethically informed<br>choices. Appreciate and respect diversity.<br>Act with integrity as part of local, national,<br>global and professional communities.   | 10 Sustainability, societal & environmental impact |

#### **Practical work:**

| Sr.No | Title | Learning Outcomes |
|-------|-------|-------------------|
|       |       |                   |

![](_page_24_Picture_0.jpeg)

| 1  | Write a Program to Blink LED's<br>connected<br>to STK – 2148 kit.   | Able to Write Program for LPC2148 microcontroller.                         |
|----|---|--|
| 2  | Write a program to take input from<br>push button switches SW1 to SW8<br>(connected from P1.16 to P1.23) and<br>show its status on<br>corresponding LED's D9 to D16<br>present on STK-2148. | Able to interface switch and LED with LPC2148                              |
| 3  | Write a program to interface relay withLPC2148.   | Able to interface relay with LPC2148.                                      |
| 4  | Write a program to display message on 16x2 Text LCD.  | Able to interface 16x2 LCD with LPC2148.                                   |
| 5  | Write a Program to transfer massage<br>"Hello world!" serially at 19200-baud<br>rate 8-bit data and 1 stop-bit using<br>UART0.  | Able to interface any serial communication-<br>based devices with LPC2148. |
| 6  | Write a program to interface 4*4 matrix keypad.   | Able to interface Keypad with LPC2148.                                     |
| 7  | Write a program for on-chip ADC (ADC 0,Channel 1, and P0.28).   | Able to interface any analog sensor with LPC2148.                          |
| 8  | Write a program to generate ramp<br>wave using on-chip DAC (P0.25)  | Able to convert form digital to analog using LPC2148.                      |
| 9  | Write a program to interface<br>128x64Graphics LCD.   | Able to interface GLCD with LPC2148.                                       |
| 10 | Write a program to display numbers<br>on 7 segment displays using I2C<br>protocol.  | Able to interfacing 7 segment with LPC2148.                                |

#### Lecture/tutorial times

(Give lecture times in the format below)

#### Example:

Lecture

Monday- 10:00 AM-11:00 AM

Thursday- 3:10 PM- 4:10 PM

Friday- 11.10AM- 12.10PM

Dreation

![](_page_25_Picture_0.jpeg)

#### **Attendance Requirements**

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

#### Details of referencing system to be used in written work

#### Text books

- 1. Raj Kamal, "Embedded System Architecture, Programming and Design", Tata McGraw-Hill, ISBN 13: 9780073404561
- 2. Steve Furber, "ARM System on Chip Architecture", Pearson Education, ISBN: 9788129711960
- 3. Wayne Wolf, "Computer as Components: Principles of Embedded Computing System Design", Morgan Kaufmann Publication
- 4. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", Morgan Kaufmann Publishers

#### **Additional Materials**

1. Embedded System Course (http://nptel.ac.in/courses/108102045/)

![](_page_26_Picture_0.jpeg)

#### **ASSESSMENT GUIDELINES**

Your final course mark will be calculated from the following:

Seminar Presentation -10 Marks

Quiz- 10 Marks

**Example:** 

MSE (40 Marks)

ESE (40 Marks)

#### SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

#### Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

#### Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

#### Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.

![](_page_27_Picture_0.jpeg)

#### **Retention of Written Work**

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

#### **University and Faculty Policies**

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

**Plagiarism** - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

#### Do not copy the work of other students.

Do not share your work with other students (except where required for a group activity or assessment)

![](_page_28_Picture_0.jpeg)

#### **Course schedule (subject to change)**

•

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

| Week #  | Topic & contents  | CO Addressed | Teaching<br>Learning<br>Activity (TLA) |
|---------|---|--------------|--|
| Weeks 1 | Introduction to Embedded System,<br>Embedded system components,<br>Embedded system design process<br>classification | 1,2          | BB, PPT                                |
| Weeks 2 | Examples of an Embedded systems, Applications of an Embedded System   | 1,2          | BB, PPT                                |
| Week 3  | Introduction to ARM architecture,<br>Programming model, Registers   | 1,2          | BB, PPT                                |
| Week 4  | 3-Stage pipeline, 5 stage pipeline,<br>Interrupts   | 1,2          | BB, PPT                                |
| Week 5  | Hazards in the pipeline, ARM<br>Instruction Set-Data Transfer<br>instructions, Branch Instructions                  | 2,3          | BB, PPT                                |
| Week 6  | Load and Store Instructions,<br>Software-Interrupt Instructions,<br>Assembly Language Programs                      | 2,3          | BB, PPT                                |
| Week 7  | Thumb Instructions Set  | 2,3          | BB, PPT                                |
| Week 8  | Inter process Communications-<br>Thread, Task   | 3,4          | BB, PPT                                |
| Week 9  | Semaphore, Scheduling,<br>Deadlocks   | 3,4          | BB, PPT                                |
| Week 10 | Operating System Services,<br>Process Management, Memory<br>Management, Device, file, I/O<br>Management             | 3,4          | BB, PPT                                |

![](_page_29_Picture_0.jpeg)

| Week 11 | RTOS Environment, basic design using RTOS                                | 5 | BB, PPT |
|---------|--|---|---------|
| Week 12 | RTOS Task scheduling models,<br>Interrupt latency, OS security<br>issues | 5 | BB, PPT |

![](_page_30_Picture_0.jpeg)

![](_page_30_Figure_1.jpeg)

![](_page_31_Picture_0.jpeg)

#### Name of Institute: INSTITUTE OF TECHNOLOGY & ENGINEERING Name of Faculty: Prof. Sejal Thakkar.

#### Course code: EC0733

Course name: Machine Learning Pre-requisites: NIL Credit points: 4 Offered Semester: III

#### **Course Coordinator**

Full Name: Sejal Thakkar Department with siting location: Computer Engineering (4<sup>rd</sup> floor,Faculty room, Bhanwar building) Telephone: 9033380982,7990552332 Email: sejalthakkar.ce@indusuni.ac.in Consultation times: Wednesday (4:00 PM to 5:00 PM)

Students will be contacted throughout the Session via Mail with important information relating to this Course.

#### Course Objectives

By participating in and understanding all facets of this Course a student will:

- 1. Understand the key algorithms and theory that form the foundation of Machine Learning.
- 2. Understand a wide variety of learning algorithms.
- 3. Recognize the characteristics of machine learning that make it useful to real-world problems.
- 4. Understand how to perform evaluation of learning algorithms and model selection.
- 5. Develop skills of using recent machine learning software in order to solve practical problems.
- 6. Understand and learn state of the art machine learning techniques to provide employability in industry.

#### Course Outcomes (CO)

After successful completion of the course, student will able:

1. Get exposure of machine learning concepts and range of problems that can be handled by machine learning

![](_page_32_Picture_0.jpeg)

- 2. Compare and parameterize different learning algorithms
- 3. Apply the machine learning concepts in real life problems
- 4. Understand learning in machines with different techniques
- 5. Understand and apply various recognition techniques.
- 6. Learn about parameter selection and feature extraction. Compare and parameterize different learning algorithms
- 7. Learn comparison of various algorithms

#### **Course Outline**

CNN, ANN, Regression, Classification

#### Method of delivery

- 1. Chalk & Talk
- 2. PPT presentation

#### Study time

3 lectures per week

2 hour labs per week

#### **CO-PO Mapping (PO: Program Outcomes)**

| Course<br>Outcome | Program Outcomes  |  |              |              |  |  |              |              |  |          |              |              | Program<br>Specific<br>Outcomes |              |              |
|-------------------|---|--|--------------|--------------|--|--|--------------|--------------|--|----------|--------------|--------------|---------------------------------|--------------|--------------|
| 0 4000000         | PO         PO10         PO11         PO12           1         2         3         4         5         6         7         8         9         PO10         PO11         PO12 |  |              |              |  |  |              |              |  | PSO<br>1 | PSO<br>2     | PSO<br>3     |                                 |              |              |
| CO1               |   |  |              |              |  |  |              |              |  |          | $\checkmark$ | $\checkmark$ | $\checkmark$                    | $\checkmark$ | $\checkmark$ |
| CO2               |   |  | $\checkmark$ |              |  |  |              |              |  |          |              |              | $\checkmark$                    |              | $\checkmark$ |
| CO3               |   |  |              | $\checkmark$ |  |  | $\checkmark$ |              |  |          | $\checkmark$ | $\checkmark$ | $\checkmark$                    |              | $\checkmark$ |
| CO4               | $\checkmark$  |  | $\checkmark$ |              |  |  |              |              |  |          | $\checkmark$ |              | $\checkmark$                    |              | $\checkmark$ |
| CO5               |   |  |              |              |  |  |              |              |  |          |              | $\checkmark$ | $\checkmark$                    | $\checkmark$ | $\checkmark$ |
| CO6               |   |  |              |              |  |  |              |              |  |          |              |              | $\checkmark$                    |              | $\checkmark$ |
| <b>CO7</b>        |   |  |              |              |  |  |              | $\checkmark$ |  |          |              |              | $\checkmark$                    |              | $\checkmark$ |

Blooms Taxonomy and Knowledge retention (For reference) (Blooms taxonomy has been given for reference)

![](_page_33_Picture_0.jpeg)

![](_page_33_Figure_1.jpeg)

#### **Graduate Qualities and Capabilities covered**

(Qualities graduates harness crediting this Course)

| General Graduate Qualities  | Specific Department ofGraduate<br>Capabilities     |
|---|--|
| Informed<br>Have a sound knowledge of an area of study<br>or profession and understand its current<br>issues, locally and internationally. Know how<br>to apply this knowledge. Understand how an<br>area of study has developed and how it<br>relates to other areas.  | 1 Professional knowledge, grounding &<br>awareness |
| Independent learners<br>Engage with new ideas and ways of thinking<br>and critically analyze issues. Seek to extend<br>knowledge through ongoing research, enquiry<br>and reflection. Find and evaluate information,<br>using a variety of sources and technologies.<br>Acknowledge the work and ideas of others. | 2 Information literacy, gathering & processing     |
| Problem solvers   | 4 Problem solving skills                           |

![](_page_34_Picture_0.jpeg)

| Take on challenges and opportunities. Apply<br>creative, logical and critical thinking skills to<br>respond effectively. Make and implement<br>decisions. Be flexible, thorough, innovative<br>and aim for high standards. |   |
|--|---|
| Effective communicators  | 5 Written communication                     |
| Articulate ideas and convey them effectively   | 6 Oral communication                        |
| using a range of media. Work collaboratively   | 7 Teamwork                                  |
| and engage with people in different settings.  |   |
| Recognize how culture can shape  |   |
| communication.   |   |
| Responsible  | 10 Sustainability, societal & environmental |
| Understand how decisions can affect others   | impact                                      |
| and make ethically informed choices.   |   |
| Appreciate and respect diversity. Act with   |   |
| integrity as part of local, national, global and   |   |
| professional communities.  |   |

#### Practical work:

(Mention what practical work this Course involves) As a part of practical, student have to perform various Python in machine learning project relevant activities.

#### Lecture/tutorial times

(Give lecture times in the format below)

#### For 3 Sem IT A and B

Monday:11 AM to 12 PM: LectureMonday:2 PM to 4: 10 PM: LaboratoryTuesday:11:10 AM to 12:10 PM: LectureWednesday:11:10 AM to 12:10 PM: LectureFriday:2 PM to 4:10 PM: Laboratory

#### **Attendance Requirements**

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

#### Details of referencing system to be used in written work

![](_page_35_Picture_0.jpeg)

#### Text books

#### **Text Book :**

- 1. Compare and parameterize different learning algorithms
- 2. Compare and parameterize different learning algorithms

#### Additional Materials

**Reference Book:** 

#### ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

| Exan | Example:   |  |  |  |  |  |
|------|--|--|--|--|--|--|
|      | Theory:Internal evaluation20% Objective (1-3-4)  |  |  |  |  |  |
|      | 10 marks as attendance 5 bonus for all students having attendance > 80%10 marks for assignment or case studies, limited to minimum 02 assignments per courseMid semester40% (due week 10)Objectives (2-5)Final exam (closed book)40%Objectives (1-5) |  |  |  |  |  |
|      | Practical:<br>20% for Internal Project<br>20% Lab file<br>20% Research related activities/Presentations<br>40% end semester project exam +Viva   |  |  |  |  |  |

#### SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

#### Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.


#### Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

#### Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.

#### **Retention of Written Work**

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

#### **University and Faculty Policies**

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

**Plagiarism** - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

#### Do not copy the work of other students.

Do not share your work with other students (except where required for a group activity or assessment)



# Course schedule (subject to change)

•

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

| Week #  | Topic & contents  | CO Addressed | Teaching<br>Learning<br>Activity (TLA) |
|---------|---|--------------|--|
| Weeks 1 | Introduction<br>Learning Problems, designing a learning<br>system, Issues with machine learning.<br>Concept Learning, Version Spaces and<br>Candidate Eliminations.   | CO1          | Chalk & Board ,<br>PPT                 |
| Weeks 2 | Inductivebias, Supervised/Unsupervised<br>Learning,<br>Loss functions and generalization,<br>Parametric vs Non-parametric methods,<br>Evaluating Machine<br>Learning algorithms and Model Selection   | CO1,<br>CO2  | Chalk & Board ,<br>PPT                 |
| Week 3  | Introduction to Statistical Learning Theory,<br>Ensemble Methods, Bagging, Boosting,<br>Random<br>Forest  | CO4          | Chalk & Board ,<br>PPT                 |
| Week 4  | Supervised Learning<br>Regression/Classification) Basic methods:<br>Distance-based methods,<br>Nearest-Neighbors, Decision Trees, Naive<br>Bayes, Linear models: Linear Regression,<br>Logistic Regression, Generalized Linear<br>Models.                     | CO3,CO4,CO5  | Chalk & Board ,<br>PPT                 |
| Week 5  | Support Vector Machines, Nonlinearity and<br>Kernel Methods, Beyond Binary<br>Classification: Multi-class/Structured<br>Outputs, Ranking Unsupervised Learning<br>Clustering: K-means/Kernel K-means,<br>Dimensionality Reduction -PCA, CCA, LDA,<br>ICA, MNF | CO4,CO5      | Chalk & Board ,<br>PPT                 |
|         |   |              |  |
| Week 6  | Canonical Variates - Feature Selection vs<br>Feature Extraction, Generative Models<br>(mixture models and latent factor models)   | CO5          | Chalk & Board , PPT                    |

| <br>    |  | Ŭ                     | ्रानेन प्रकाशते जगत्<br>INDUS<br>UNIVERSITY |
|---------|--|-----------------------|---|
| Week 7  | Bayesian Learning<br>Bayes Theorem, Bayes Theorem and<br>Concept Learning, Maximum Likelihood<br>and Least squared<br>Error Hypothesis, Maximum likelihood<br>hypothesis for Predicting Probabilities. | CO2,CO3,CO5           | Chalk & Board , PPT                         |
| Week 8  | Minimum<br>Description Length, Principle, Bayes<br>Optimal Classifier, Gibbs Algorithm, Naïve<br>Bayes, Classifier.  | CO4, CO6              | Chalk & Board , PPT                         |
| Week 9  | Bayesian Belief Network, EM Algorithm,<br>Case Study: Learning to classify text.   | CO5                   | Chalk & Board , PPT                         |
| Week 10 | Artificial Neural networks<br>Neural Network Representation,<br>Appropriate problems for Neural Network<br>Learning, Perceptron,<br>Multilayer Networks and Back<br>Propagation,                       | CO2, CO3, CO5,<br>CO7 | Chalk & Board , PPT                         |
| Week 11 | Algorithms, Remarks on Back Propagation<br>Algorithms, Case Study: face Recognition<br>Advanced topics<br>Semi-supervised, Active Learning,<br>Reinforcement Learning,                                 | CO2, CO5, CO7         | Chalk & Board , PPT                         |
| Week 12 | Recent trends in various learning<br>techniques of machine learning and<br>classification methods, Overview of typical<br>application areas, such as Recommender<br>System.                            | CO2, CO5, CO7         | Chalk & Board , PPT                         |



#### PROGRAM MAP for Bachelor of Engineering (Electronics and Communication)





#### Name of Institute: Institute of Technology & Engineering

Name of Faculty: Omkar Pabbati Course code: EC0729

#### **Course name: Wireless Communication**

Pre-requisites: Analog & Digital Communication Credit points: 4 Offered Semester: 7th

#### Course coordinator (weeks 01 - 14)

Full name: Omkar Pabbati Department with siting location: Electronics & Communication Engineering Telephone:

Email: omkarpabbati.ec@indusuni.ac.in Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

#### **Course lecturer (weeks 01 - 14)**

Full name: Omkar Pabbati Department with siting location: Electronics & Communication Engineering Telephone:

Email: omkarpabbati.ec@indusuni.ac.in Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

Students will be contacted throughout the session via mail with important information relating to this course.

#### **Course Objectives**

- To Understand the era of wireless communication system
- Get the knowledge of all important concept of wireless systems
- Implement the propagation model for different environments
- Understand the working of today's GSM and CDMA architecture
- Know the recent trends in wireless communication systems

#### **Course Outcomes (CO)**

- 1. Characterize a wireless channel and evolve the system design specifications
- 2. Design a cellular system based on resource availability and traffic demands.
- 3. Implement various signaling schemes for fading channels.
- 4. Identify suitable signaling and multipath mitigation techniques for the wireless channel
- 5. Design and implement systems with transmit / receive diversity.



6. Analyze the performance of MIMO systems

## **Course Outline**

| Unit<br>No.  | Τορία   | CS  |  |  |  |  |  |  |
|--|---|---|--|--|--|--|--|--|
| 1  | Eleme<br>Gene<br>Interf<br>of Sei   | Elements of Cellular Radio System Design Introduction of cellular system,<br>General description of problem, Concept of frequency reuse channels,<br>Interferences, Handoff mechanism, Umbrella concept, Trunking and Grade<br>of Service, Techniques to improve coverage and capacity in cellular system   |  |  |  |  |  |  |
| 2  | Frequency Management and Channel Assignment Frequency management,<br>Frequency-spectrum utilization, Set-up channels, Definition of channel<br>assignment, Fixed channel assignment, Nonfixed channel assignment<br>algorithms, Traffic and channel assignment, Value of implementing<br>handoffs, Initiation of a handoff, delaying a handoff, Forced handoffs,<br>power-difference handoffs, Mobile assisted handoff and soft handoff,<br>Introduction to dropped call rate, Formula of dropped call rate |   |  |  |  |  |  |  |
| 3  | <sup>3</sup> Multiple access techniques and Propagation models of Mobile Radio FDMA<br>TDMA, CDMA, OFDM, Radio wave propagation, Transmit and receive signa<br>models, Free-Space path loss, Ray tracing, Empirical path-loss models<br>Shadow fading,Combined pathloss and shadowing, Outage probabilit  |   |  |  |  |  |  |  |
| 4 Digital Cellular Systems GSM architecture, GSM of<br>coding, Location tracking and call setup,<br>Supplementary service data, GSM location up<br>Failure restoration, CDMA architecture, RAKE<br>channel specifications, PDC,PHS,WCDMA,GPR<br>Introduction to Wi-Fi, WiMAX, ZigBee Networks<br>UWB radio, Wireless Adhoc network and mobile<br>and challenges in a wireless network. |   | I Cellular Systems GSM architecture, GSM channel types, GSM speech<br>g, Location tracking and call setup, security, Data services,<br>ementary service data, GSM location update, Mobility databases,<br>e restoration, CDMA architecture, RAKE receiver, Frequency and<br>nel specifications, PDC,PHS,WCDMA,GPRS system architecture,<br>fuction to Wi-Fi, WiMAX, ZigBee Networks, Software defined radio,<br>radio, Wireless Adhoc network and mobile portability, Security issues<br>hallenges in a wireless network. |  |  |  |  |  |  |
| Text<br>books:   |   | <ol> <li>Mobile Cellular Telecommunications analog and digital systems,<br/>William C. Y. Lee. 2nd Edition, MGH.</li> <li>Wireless Communication", Theodore S. Rappaport, Prentice hall.</li> </ol>   |  |  |  |  |  |  |
| Reference<br>Books/Note<br>s   |   | <ol> <li>Wireless and Mobile Network Architecture by YI-Bang Lin and<br/>Imrich Chlamtac, Wiley publication.</li> <li>"Wireless Communications and Networking ",Vijay Garg, Elsevier</li> <li>Mobile and personal Communication system and services by<br/>Rajpandya, IEEE press(PHI)</li> </ol>  |  |  |  |  |  |  |



#### Method of delivery

- 1. Chalk and talk
- 2. PowerPoint Presentations
- 3. Self-study material
- 4. NPTEL notes

#### **Study time**

3 hours per week Lectures

|             | PO<br>1      | P<br>0<br>2  | РО<br>3      | РО<br>4 | РО<br>5      | РО<br>6 | РО<br>7 | РО<br>8 | РО<br>9      | PO1<br>0 | P01<br>1 | PO1<br>2 |
|-------------|--------------|--------------|--------------|---------|--------------|---------|---------|---------|--------------|----------|----------|----------|
| CO1         | $\checkmark$ |              | $\checkmark$ |         | $\checkmark$ |         |         |         | $\checkmark$ |          |          |          |
| CO2         | $\checkmark$ |              | $\checkmark$ |         | $\checkmark$ |         |         |         | $\checkmark$ |          |          |          |
| CO3         | $\checkmark$ |              |              |         | $\checkmark$ |         |         |         | $\checkmark$ |          |          |          |
| <b>CO</b> 4 | $\checkmark$ |              | $\checkmark$ |         | $\checkmark$ |         |         |         | $\checkmark$ |          |          |          |
| CO5         | $\checkmark$ |              | $\checkmark$ |         | $\checkmark$ |         |         |         |              |          |          |          |
| CO6         | $\checkmark$ | $\checkmark$ | $\checkmark$ |         | $\checkmark$ |         |         |         |              |          |          |          |

#### **CO-PO Mapping (PO: Program Outcomes)**

**Blooms Taxonomy and Knowledge retention (For reference)** (Blooms taxonomy has been given for reference)







# Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

| General Graduate Qualities   | Specific Department of                             |
|--|--|
|  | Graduate Capabilities                              |
| Informed<br>Have a sound knowledge of an area<br>of study or profession and<br>understand its current issues, locally<br>and internationally. Know how to<br>apply this knowledge. Understand<br>how an area of study has developed<br>and how it relates to other areas.                          | 1 Professional knowledge,<br>grounding & awareness |
| Engage with new ideas and ways of<br>thinking and critically analyze<br>issues. Seek to extend knowledge<br>through ongoing research, enquiry<br>and reflection. Find and evaluate<br>information, using a variety of<br>sources and technologies.<br>Acknowledge the work and ideas of<br>others. | & processing                                       |
| <b>Problem solvers</b><br>Take on challenges and<br>opportunities. Apply creative, logical<br>and critical thinking skills to respond<br>effectively. Make and implement<br>decisions. Be flexible, thorough,<br>innovative and aim for high<br>standards.   | 4 Problem solving skills                           |
| Effective communicators  | 5 Written communication                            |
| Articulate ideas and convey them   | 6 Oral communication                               |
| effectively using a range of media.<br>Work collaboratively and engage   | 7 Teamwork   |



| with people in different settings.<br>Recognize how culture can shape<br>communication.  |  |
|--|--|
| <b>Responsible</b><br>Understand how decisions can affect<br>others and make ethically informed<br>choices. Appreciate and respect<br>diversity. Act with integrity as part<br>of local, national, global and<br>professional communities. | 10 Sustainability, societal & environmental impact |

#### Lecture/tutorial times

(Give lecture times in the format below)

#### Details of referencing system to be used in written work

- 1. Text Books and Reference Books
- 2. Online Resources

#### **Text books**

Mention in syllabus

#### **Additional Materials**

#### **ASSESSMENT GUIDELINES**

Your final course mark will be calculated from the following:

Theory CIE 60 marks:

 a. Midsem exam: 40 Marks
 b. Assignment: 10 Marks
 c. Quiz: 10 Marks

 Practical CIE 60 marks:

 a. Experiment Performance 30 Marks
 b. File work + Skill Test 20 Marks

c. Internal Viva 10 Marks



#### SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

#### **Practical Work Report/Laboratory Report:**

A report on the practical work is due the subsequent week after completion of the class by each group.

#### Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 10 % of the maximum mark per calendar day

#### Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.

#### **Retention of Written Work**

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

#### **University and Faculty Policies**

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

**Plagiarism** - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

# *Do not copy the work of other students. Do not share your work with other students (except where required for a group activity or assessment)*



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**Course schedule (subject to change)** (Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

| Week #  | Topic & contents   | CO<br>Addressed | Teaching<br>Learning<br>Activity<br>(TLA)        |
|---|--|-----------------|--|
| Weeks 1   | Elements of Cellular Radio<br>System Design Introduction of<br>cellular system, General<br>description of problem,<br>Concept of frequency<br>reuse channels, Interferences,<br>Handoff mechanism, Umbrella<br>concept, Trunking               | C01             | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Weeks 2   | Grade of Service, Techniques to<br>improve coverage and capacity<br>in cellular system   | CO1 CO2         | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 3  | Frequency Management and<br>Channel Assignment<br>Frequency management,<br>Frequency-spectrum utilization,<br>Set-up channels, Definition of<br>channel assignment, Fixed<br>channel assignment, Nonfixed<br>channel assignment<br>algorithms, | CO1 CO3         | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 4  | Traffic and channel<br>assignment, Value of<br>implementing handoffs,<br>Initiation of<br>a handoff, delaying a handoff,<br>Forced handoffs,   | CO2             | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Power-difference handoffs,<br>Mobile<br>assisted handoff and soft<br>Week 5 handoff, Introduction to<br>dropped call rate, Formula of<br>dropped<br>call rate |  | CO1 CO3         | Chalk and<br>talk<br>PowerPoint<br>Presentations |
|   |  |                 |  |
| Week 6  | Multiple access techniques and<br>Propagation models of Mobile<br>Radio  | CO2 CO3         | Chalk and<br>talk<br>PowerPoint                  |

|         |   |         | ज्ञानेन प्रकाशते जगत्<br>INDUS<br>UNIVERSITY     |
|---------|---|---------|--|
|         | FDMA, TDMA, CDMA, OFDM,<br>Radio wave propagation,  |         | Presentations                                    |
| Week 7  | Transmit and receive signal<br>models, Free-Space path loss,<br>Ray tracing, Empirical path-<br>loss models, Shadow fading,   | CO3 CO5 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 8  | Combined pathloss and<br>shadowing, Outage probability<br>under path loss and shadowing,<br>cell coverage area.   | CO2 CO3 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 9  | GSM architecture, GSM channel<br>types, GSM speech coding,<br>Location tracking and call<br>setup, security, Data services,<br>Supplementary service data,<br>GSM location update,<br>Mobility databases, | CO2 CO3 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 10 | Failure restoration, CDMA<br>architecture, RAKE receiver,<br>Frequency<br>and channel specifications,   | CO2 CO5 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 11 | PDC,PHS,WCDMA,GPRS system architecture,   | CO4 CO5 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 12 | Introduction<br>to Wi-Fi, WiMAX, ZigBee<br>Networks, Software defined<br>radio, UWB radio   | CO4 CO5 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 13 | Wireless Adhoc network and<br>mobile portability, Security<br>issues and challenges in a<br>wireless network.   | C05     | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 14 | Revision  | C05     | Chalk and<br>talk<br>PowerPoint<br>Presentations |



**Program map for B.Tech (Electronics & Communication Engineering)** 





#### Name of Institute: Indus Institute of Technology & Engineering Name of Faculty: Prof. Zalak Patel

#### Course code: EC0721

#### **Course name: Antenna & Wave Propagation**

Pre-requisites: Electromagnetic, Microwave Engineering Credit points: 04 Offered Semester: 6<sup>th</sup>

#### **Course Coordinator (weeks 15)**

Full Name: Prof. Zalak Patel Department with sitting location: EC (Antenna & Microwave Lab), Bhanwar Building Telephone: 3203 Email: zalakpatel.ec@indusuni.ac.in Consultation times: 3:30 to 4:15 PM

#### **Course Lecturer (weeks 15)**

Full Name: Prof. Zalak Patel Department with sitting location: EC (Antenna & Microwave Lab), Bhanwar Building Telephone: 3203 Email: zalakpatel.ec@indusuni.ac.in Consultation times: 3:30 to 4:15 PM

Students will be contacted throughout the Session via Mail with important information relating to this Course.

#### **Course Objectives**

By participating in and understanding all facets of this Course a student will:

- 1. The objective of this subject is to deliver an in-depth knowledge of the basic antennas and their applications.
- 2. To give the practical design consideration and simulation of various antennas for different applications.
- 3. To cover the basic theoretical concepts for the radio wave propagation.

#### **Course Outcomes (CO)**

After completion of this course, expected outcome from the students,

1. To understand the different types of antennas and the radiation mechanism.



**Miscellaneous Antennas** 

- 2. To evaluate the fundamental parameters of antennas and arrays of antennas.
- 3. To acquire ability to design various types of linear and planar antennas.
- 4. To understand the atmospheric and terrestrial effects on radio wave propagation.

**Course Outline** 

(Key in topics to be dealt)

#### UNIT-I

#### **Overview of antennas**

Definitions, Types of Antennas & applications, Current distribution on a thin wire antenna, Radiation mechanism, Antenna parameters, radiation pattern, antenna field zones, radiation power density, radiation intensity, directivity, gain, antenna efficiency, half-power beamwidth, first null beamwidth, beam efficiency, bandwidth, polarization, input impedance, antenna radiation efficiency, antenna effective area, Friss transmission equation.

#### UNIT-II

#### **Radiation integral**

Vector potential A and F for Electric & Magnetic current sources | & M, E and H field for electric and magnetic current sources, Far field radiation, reciprocity theorem, radiation form current element and dipole, radiation patterns of different dipoles, radiation power density, radiation resistance & directivity of dipole.

#### UNIT-III

#### **Antenna Arrays**

Two-element array, N-element linear array- Uniform amplitude & spacing, array/space factor, broadside array, end-fire array, N-element linear array-Uniform spacing & non uniform amplitude, planar array, introduction to active phased (scanning) array and adaptive arrays.

#### **Wave Propagation**

Ground wave propagation, terrain and earth curvature effects, tropospheric propagation, fading, diffraction and scattering, ionospheric propagation, refractive index, critical frequencies, maximum usable frequency, effects of magnetic field.

#### **UNIT-IV**

[10 hours]

[12 hours]

## [12 hours]

[10 hours]



Huygen's Field Equivalence Principle, Babinet's principle, Slot Antennas, Horn

| PO |   |              |   |   |   | Ρ | 0            |   |   |    |    |    |
|----|---|--------------|---|---|---|---|--------------|---|---|----|----|----|
| C0 | 1 | 2            | 3 | 4 | 5 | 6 | 7            | 8 | 9 | 10 | 11 | 12 |
| 1  |   |              |   |   |   |   | $\checkmark$ |   |   |    |    |    |
| 2  |   |              |   |   |   |   | $\checkmark$ |   |   |    |    |    |
| 3  |   | $\checkmark$ |   |   |   |   |              |   |   |    |    |    |
| 4  |   |              |   |   |   |   |              |   |   |    |    |    |

Antennas, Reflector Antennas, Micorstrip Patch Antennas, Helical Antennas, Loop Antennas.

#### **Method of delivery**

(Face to face lectures, self study material, Active Learning Techniques)

#### **Study time**

(5 hours per week including class attendance)

#### **CO-PO Mapping (PO: Program Outcomes)**

#### **Blooms Taxonomy and Knowledge retention(For reference)** (Blooms taxonomy has been given for reference)



Figure 1: Blooms Taxonomy





# Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

| General Graduate Qualities   | Specific Department of                             |
|--|--|
|  | Graduate Capabilities                              |
| Informed<br>Have a sound knowledge of an area<br>of study or profession and<br>understand its current issues, locally<br>and internationally. Know how to<br>apply this knowledge. Understand<br>how an area of study has developed<br>and how it relates to other areas.                          | 1 Professional knowledge,<br>grounding & awareness |
| Engage with new ideas and ways of<br>thinking and critically analyze<br>issues. Seek to extend knowledge<br>through ongoing research, enquiry<br>and reflection. Find and evaluate<br>information, using a variety of<br>sources and technologies.<br>Acknowledge the work and ideas of<br>others. | & processing                                       |
| <b>Problem solvers</b><br>Take on challenges and<br>opportunities. Apply creative, logical<br>and critical thinking skills to respond<br>effectively. Make and implement<br>decisions. Be flexible, thorough,<br>innovative and aim for high<br>standards.   | 4 Problem solving skills                           |
| Effective communicators  | 5 Written communication                            |
| Articulate ideas and convey them   | 6 Oral communication                               |
| effectively using a range of media.<br>Work collaboratively and engage   | 7 Teamwork   |



| with people in different settings.    |                               |
|---------------------------------------|-------------------------------|
| Recognize how culture can shape       |                               |
| communication.                        |                               |
| Responsible                           | 10 Sustainability, societal & |
| Understand how decisions can affect   | environmental impact          |
| others and make ethically informed    |                               |
| choices. Appreciate and respect       |                               |
| diversity. Act with integrity as part |                               |
| of local, national, global and        |                               |
| professional communities.             |                               |

#### **Practical work:**

(Mention what practical work this Course involves)

| Experime | Title  | Learning Outcomes  |
|----------|--|--|
| nt. No.  |  |  |
| 1        | To study the variation of field<br>strength with respect to<br>distance from transmitting<br>antenna.  | To understand the relationship<br>between the field strength and<br>distance from the transmitting<br>antenna.               |
| 2        | Demonstrate that the<br>transmitting and receiving<br>radiation pattern of an antenna<br>are equal; therefore confirm the<br>reciprocity theorem of<br>antennas. | To understand the reciprocity<br>theorem for Antennas and their<br>radiation patterns.                                       |
| 3        | To plot the radiation pattern of<br>an Omni directional antenna.   | To acquire the basic<br>understanding of<br>Omnidirectional antennas and<br>to plot its radiation pattern on<br>polar graph. |
| 4        | To plot radiation pattern of directional antenna.  | To acquire the basic<br>understanding of<br>Omnidirectional antennas and<br>to plot its radiation pattern on<br>polar graph. |
| 5        | To study and plot the radiation<br>pattern of the helical antennas<br>and measure Gain and Beam<br>width.  | To calculate the gain and<br>beamwidth of helical antenna<br>from its measured radiation<br>pattern.                         |
| 6        | To study and plot the radiation<br>pattern of the Broadside array<br>and measure Gain and Beam<br>width.   | To calculate the gain and<br>beamwidth of broadside array<br>antenna from its measured<br>radiation pattern.                 |
| 7        | Design and simulate dipole antenna in HFSS.  | To determine the design<br>parameters of dipole antenna  |



|    |  | and to observe its far field radiation pattern.   |
|----|--|---|
| 8  | Design and simulate conical horn antenna in HFSS.  | To determine the design<br>parameters of conical horn<br>antenna and to observe its far<br>field radiation pattern.     |
| 9  | Design and simulate Microstrip<br>antenna in HFSS. | To determine the design<br>parameters of Microstrip patch<br>antenna and to observe its far<br>field radiation pattern. |
| 10 | Mini Project                                       |   |

#### Lecture/tutorial times

| Lecture   | Monday   | 9.55 - 10.55 am  | Room LH 22 |
|-----------|----------|------------------|------------|
| Lecture   | Tuesday  | 1.30 - 2.25 pm   | Room LH 22 |
| Lecture   | Friday   | 9.00 9.55 pm     | Room LH 22 |
| Tutorial  | Tuesday  | 11.00 - 12.50 pm | EC lab 4   |
| Tutorial  | Friday   | 2.25 - 4.15 pm   | EC lab 4   |
| Practical | Thursday | 9.00 - 10.55 am  | EC lab 4   |
| Practical | Friday   | 11.00 - 12.50 p  | m EC lab 4 |

#### **Attendance Requirements**

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

#### Details of referencing system to be used in written work

Text books 1. Antenna Theory: Analysis and Design, 3<sup>rd</sup> Edition, C A Balanis, Wiley <u>Publication.</u> 2. Antennas, J D Krauss, Mcgraw-Hill Higher Education.

#### **Additional Materials**

#### **Reference Books**



1. Electromagnetic Wave and Radiating Systems, Edward C. & Balmain, Keith G. Jordan. Prentice Hall of India.

2. Electronic and Radio Engineering, F.E. Terman, McGraw-Hill, 4th edition, 1955.

#### Web Resources

- 1. http://nptel.ac.in/courses/117107035/
- 2. https://www.tutorialspoint.com/antenna\_theory/
- 3. http://www.radio-electronics.com/info/antennas/
- 4. http://nptel.ac.in/courses/108101092/

#### **ASSESSMENT GUIDELINES**

Your final course mark will be calculated from the following:

| Example:                          |               |                    |
|-----------------------------------|---------------|--------------------|
| Quiz 1                            | 10% (week 4)  | Objective (1-3)    |
| Class Test                        | 10% (week 6)  | Objective (1-4)    |
| Seminar                           | 10% (week 8)  | Objective          |
| (1-4)                             |               | -                  |
| Mid semester                      | 30% (due week | 10) Objectives (2- |
| 5)                                |               | -                  |
| Final exam ( <i>closed book</i> ) | <b>40%</b>    | Objectives (1-5)   |
|                                   |               |                    |

#### SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

#### **Practical Work Report/Laboratory Report:**

A report on the practical work is due the subsequent week after completion of the class by each group.

#### Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day



#### Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.

#### **Retention of Written Work**

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

#### **University and Faculty Policies**

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

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# *Do not copy the work of other students. Do not share your work with other students (except where required for a group activity or assessment)*



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# **Course schedule (Antenna & Wave Propagation)** (Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

| Week #  | Topic & contents  | CO<br>Addressed | Teaching<br>Learning<br>Activity<br>(TLA) |
|---|---|-----------------|---|
| Weeks 1   | Definitions, Types of Antennas<br>& applications, Current<br>distribution on a thin wire<br>antenna, Radiation mechanism,<br>Antenna Performance<br>parameters.   | 1               | BB, PPT                                   |
| Weeks 2   | Radiation pattern, antenna field<br>zones, radiation power density,<br>radiation intensity, directivity,<br>gain, antenna efficiency, half-<br>power beamwidth, first null<br>beamwidth, beam efficiency. | 1,2             | BB, PPT                                   |
| Week 3  | Bandwidth, polarization, input<br>impedance, antenna radiation<br>efficiency, antenna effective<br>area, Friss transmission<br>equation.  | 1,2             | BB, PPT                                   |
| Week 4  | Vector potential A and F for<br>Electric & Magnetic current<br>sources J & M, E and H field for<br>electric and magnetic current<br>sources,  | 2               | BB, PPT                                   |
| Far field radiation, reciprocity<br>theorem, Radiation formWeek 5current element and dipole,<br>radiation patterns of different<br>dipoles. |   | 2               | BB, PPT                                   |
|   |   |                 |   |
| Week 6  | Derivation of radiation power<br>density, radiation resistance &<br>directivity of infinitesimal &<br>small dipole antenna.   | 2               | BB, PPT                                   |
| Week 7  | Two-element array, N-element<br>linear array- Uniform amplitude<br>& spacing, array/space factor.   | 2               | BB, PPT                                   |
| Week 8  | Broadside array, end-fire array,<br>N-element linear array- Uniform<br>spacing & non uniform  | 2               | PPT                                       |

|         | amplitude,   |   |         |
|---------|--|---|---------|
| Week 9  | Planar array, introduction to active phased (scanning) array and adaptive arrays.  | 2 | BB, PPT |
| Week 10 | Ground wave propagation,<br>terrain and earth curvature<br>effects, tropospheric<br>propagation, fading, diffraction<br>and scattering, Space wave<br>propagation.             | 3 | BB, PPT |
| Week 11 | lonospheric propagation,<br>refractive index, critical<br>frequencies, maximum usable<br>frequency, effects of magnetic<br>field.  | 3 | BB, PPT |
| Week 12 | Huygen's Field Equivalence<br>Principle, Babinet's principle,<br>Slot Antennas, Helical<br>Antennas, Loop Antennas.  | 3 | BB, PPT |
| Week 13 | E-plane sectoral horn, aperture<br>fields, H-plane sectoral horn,<br>aperture fields, pyramidal horn,<br>conical horn, corrugated horn.  | 4 | BB, PPT |
| Week 14 | Plane reflector, corner reflector,<br>parabolic reflector, front fed<br>parabolic reflector, dual<br>symmetrical and offset<br>reflectors (Cassegrain &<br>Gregorian antenna). | 4 | BB, PPT |
| Week 15 | Basics of microstrip antennas,<br>different types, advantages and<br>disadvantages & applications,<br>meta materials, fractal<br>antennas, surface wave<br>antenna.            | 4 | BB, PPT |

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# **PROGRAM MAP FOR B.Tech. (ELECTRONICS & COMMUNICATION ENGINEERING)**

| Ist Year     |                         |                      |  |                           |                                  |                           |
|--------------|-------------------------|----------------------|--|---------------------------|----------------------------------|---------------------------|
|              |                         | _                    |  |                           |                                  | Basic Electronics         |
|              |                         |                      |  |                           | 23                               | $\square$                 |
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| 7th Samartar |                         |                      |  |                           | rephysical Carrier's James, CEPP |                           |
| 4th Year     |                         |                      |  | Easpharty professory      | warmen (ADDCCarrie) CCPID        |                           |
|              |                         |                      |  |                           |                                  | 05                        |



#### Name of Institute: Institute of Technology & Engineering Name of Faculty: Prof. Hardik Prajapati

#### **Course code: EC0707**

#### **Course name: Cryptography & Cyber Security**

Pre-requisites: Modular Arithmetic, Basic concepts of Computer Network Credit points: IV Offered Semester: VII

#### **Course coordinator**

Full name: Prof. Hardik Prajapati Department with siting location: Electronics & Communication Dept., EC Lab -1, Bhanwar Building Telephone: M: 9099374230, Extension: 3113 Email: hardikprajapati.ec@indusuni.ac.in Consultation times: Monday to Friday : 4:00 to 5:00 PM

#### **Course lecturer**

Full name: Prof. Hardik Prajapati Department with siting location: Electronics & Communication Dept., EC Lab -1, Bhanwar Building Telephone: M: 9099374230, Extension : 3113 Email: hardikprajapati.ec@indusuni.ac.in Consultation times: Monday to Friday : 4:00 to 5:00 PM

Students will be contacted throughout the session via mail with important information relating to this course.

#### **Course Objectives**

By participating in and understanding all facets of this course a student will:

- 1. Describe, apply and analyze basic network concepts emphasizing series and parallel combination of passive components, source transformation and shifting.
- 2. Describe, apply and analyze use of mesh and nodal techniques for formulating the transfer function of networks.
- 3. Apply and analyze various network theorems in solving the problems related to electrical circuits.



4. Describe and analyze two port networks and methods of analyzing the electrical networks.

#### **Course Outcomes (CO)**

- 1. Explain and make practical use of the concepts, principles and mechanisms for providing security to the information/data.
- 2. Select the optimum security protocol according to application requirement.
- 3. Design security model of application level and network level security.
- 4. Design encryption algorithms.

#### **Course Outline**

#### UNIT-I

#### Introduction

OSI Security Architecture, Classical Encryption techniques, Cipher Principles, Cryptography, Cryptanalysis and Attacks; Substitution and Transposition techniques

#### Symmetric Key Cryptography:

Stream ciphers and block ciphers, Block Cipher structure, Feistel Cipher, Diffusion and Confusion, Data Encryption standard (DES) with example, strength of DES, Design principles of block cipher, AES, Multiple encryption and triple DES, Electronic Code Book, Cipher Block Chaining Mode, Cipher Feedback mode, Output Feedback mode, Counter mode, RC4 algorithm, Confidentiality using Symmetric encryption, Key Distribution, Random Number Generator.

#### UNIT II

#### Public Key Cryptography:

Key Management, Diffie-Hellman key Exchange, Elliptic Curve Architecture and Cryptography, Introduction to Number Theory, Confidentiality using Symmetric Encryption, Public Key Cryptography and RSA.

#### **Message Authentication and Hash Functions:**

Authentication Requirements, Authentication Functions, MAC, Hash Functions, Security of Hash Functions and MACs, Secure Hash Algorithm, MD5.

#### UNIT III

#### Digital Signatures and Authentication Applications :

Authentication Protocols, Kerberos, DSS, X.509 Authentication Service, Digital Signatures

#### **Network Security:**

PGP, S/MIME, IPSec Architecture, Authentication Header, ESP, Combining Security Association, Key Management, Web Security Consideration, SSL and TLS, Introduction to E-Commerce, Secure Electronic Transaction (SET).

#### UNIT IV



#### **System Level Security:**

Intrusion detection, Password management, Viruses and related Threats, Virus Counter measures, Firewall Design Principles, Trusted Systems, DDOS attack, Smart Cards and Security, Zero Knowledge Protocol, Database Access Control.

#### **Method of delivery**

Lectures, Power Point Slides, Tutorial, Quiz, Test

#### **Study time**

5 Hours Per week

|         | PO<br>1 | РО<br>2 | PO<br>3 | РО<br>4 | РО<br>5 | РО<br>6 | РО<br>7 | РО<br>8 | РО<br>9 | PO1<br>0 | PO1<br>1 | PO1<br>2 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|
| CO<br>1 | 3       | 1       | 1       | -       | -       | -       | -       | -       | -       | -        | -        | 1        |
| CO<br>2 | 3       | 2       | 3       | 1       | 3       | -       | -       | -       | -       | -        | -        | -        |
| CO<br>3 | 3       | 2       | 2       | 2       | 3       | -       | -       | -       | -       | -        | -        | -        |
| CO<br>4 | 2       | 2       | 1       | -       | -       | -       | -       | -       | -       | -        | -        | 1        |
| CO<br>5 | 3       | 2       | 3       | 1       | 3       | -       | -       | -       | -       | -        | -        | -        |

#### **CO-PO Mapping (PO: Program Outcomes)**

**Blooms Taxonomy and Knowledge retention (For reference)** (Blooms taxonomy has been given for reference)



Subject: Cryptography & Cyber Security (EC0716)





# Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

| General Graduate Qualities   | Specific Department of  |
|--|---|
|  | Graduate Capabilities   |
| Informed<br>Have a sound knowledge of an area<br>of study or profession and<br>understand its current issues, locally<br>and internationally. Know how to<br>apply this knowledge. Understand<br>how an area of study has developed<br>and how it relates to other areas.<br>Independent learners<br>Engage with new ideas and ways of | 1 Professional knowledge,<br>grounding & awareness<br>2 Information literacy, gathering |
| thinking and critically analyze<br>issues. Seek to extend knowledge<br>through ongoing research, enquiry<br>and reflection. Find and evaluate<br>information, using a variety of<br>sources and technologies.<br>Acknowledge the work and ideas of<br>others.  | & processing  |
| <b>Problem solvers</b><br>Take on challenges and<br>opportunities. Apply creative, logical<br>and critical thinking skills to respond<br>effectively. Make and implement<br>decisions. Be flexible, thorough,<br>innovative and aim for high<br>standards.   | 4 Problem solving skills  |
| Effective communicators  | 5 Written communication   |
| Articulate ideas and convey them   | 6 Oral communication  |
| effectively using a range of media.  | 7 Teamwork  |

Subject: Cryptography & Cyber Security (EC0716)

Semester: VII (2021)



| Work collaboratively and engage<br>with people in different settings.<br>Recognize how culture can shape<br>communication.   |  |
|--|--|
| <b>Responsible</b><br>Understand how decisions can affect<br>others and make ethically informed<br>choices. Appreciate and respect<br>diversity. Act with integrity as part<br>of local, national, global and<br>professional communities. | 10 Sustainability, societal & environmental impact |

**Practical work:** No Practical

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#### Lecture/tutorial times

|--|

#### **Attendance Requirements**

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

#### Details of referencing system to be used in written work

#### **Text Books:**

William Stallings, "Cryptography and Network Security – Principles and Practices", Pearson Education, ISBN: 9780133354690

#### **Reference Books:**

1. Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, ISBN-13: 978-0471117094



2. Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill, ISBN: 9781259029882

#### Additional Materials:

PPTs of all units will be provided.

#### **ASSESSMENT GUIDELINES**

Your final course mark will be calculated from the following:

| Test 1                   | 20% |  |
|--------------------------|-----|--|
| Test II                  | 20% |  |
| Assignment 1             | 20% |  |
| Final exam (closed book) | 40% |  |
|                          |     |  |

#### SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

#### **Practical Work Report/Laboratory Report:**

No practical

#### Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day



#### Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.

#### **Retention of Written Work**

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

#### **University and Faculty Policies**

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

**Plagiarism** - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

# *Do not copy the work of other students. Do not share your work with other students (except where required for a group activity or assessment)*



# **Course schedule (subject to change)**

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| Week #  | Topic & contents   | CO<br>Addressed | Teaching<br>Learning<br>Activity (TLA) |
|---------|--|-----------------|--|
| Weeks 1 | Introduction: OSI Security<br>Architecture, Classical<br>Encryption techniques, Cipher<br>Principles, Cryptography,<br>Cryptanalysis and Attacks;<br>Substitution and Transposition<br>techniques                  | 1               | Lecture &<br>Tutorial                  |
| Weeks 2 | SymmetricKeyCryptographyStream ciphers and blockciphers, Block Cipher structure,Feistel Cipher, Diffusion andConfusion,  | 1,2             | Lecture &<br>Tutorial                  |
| Week 3  | Data Encryption standard (DES)<br>with example, , strength of DES,<br>Design principles of block<br>cipher, AES, Multiple encryption<br>and triple DES, Electronic Code<br>Book                                    | 1,2             | Lecture ,<br>Tutorial & Test           |
| Week 4  | Cipher Block Chaining Mode,<br>Cipher Feedback mode, Output<br>Feedback mode, Counter mode,<br>RC4 algorithm, Confidentiality<br>using Symmetric encryption,<br>Key Distribution, Random<br>Number Generator, Test | 2,3             | Lecture &<br>Tutorial                  |
| Week 5  | Public Key CryptographyKeyManagement,Diffie-Hellman key Exchange,EllipticCurveArchitectureandCryptography,IntroductiontoNumberTheory,ConfidentialityusingSymmetricEncryption                                       | 1,3             | Lecture &<br>Tutorial                  |
|         |  |                 |  |
| Week 6  | Public Key Cryptography and<br>RSA, Authentication<br>Requirements, Authentication<br>Functions, MAC, Hash<br>Functions, Security of Hash  | 1,4             | Lecture ,<br>Tutorial & Test           |

Subject: Cryptography & Cyber Security (EC0716)

|  |         |   |     | ज्ञानेन प्रकाशते जगत्<br>INDUS<br>UNIVERSITY |
|--|---------|---|-----|--|
|  |         | Functions and MACs, Secure Hash Algorithm, MD5, Test  |     |  |
|  | Week 7  | Authentication Protocols,<br>Kerberos, DSS, X.509<br>Authentication Service, Digital<br>Signatures                                    | 1,4 | Lecture &<br>Tutorial                        |
|  | Week 8  | PGP, S/MIME, IPSec Architecture,<br>Authentication Header, ESP,<br>Combining Security Association,<br>Key Management                  | 1,4 | Lecture &<br>Tutorial                        |
|  | Week 9  | Web Security Consideration, SSL<br>and TLS, Introduction to E-<br>Commerce, Secure Electronic<br>Transaction (SET), Test              | 1   | Lecture ,<br>Tutorial & Test                 |
|  | Week 10 | Intrusion detection, Password<br>management, Viruses and<br>related Threats, Virus Counter<br>measures, Firewall Design<br>Principles | 5,6 | Lecture &<br>Tutorial                        |
|  | Week 11 | Trusted Systems, DDOS attack,<br>Smart Cards and Security, Zero<br>Knowledge Protocol, Database<br>Access Control                     | 5,6 | Lecture &<br>Tutorial                        |
|  | Week 12 | Revision , Test   | 5,6 | Lecture &<br>Tutorial                        |



## **Program map for B.Tech (Electronics & Communication Engineering)**



Subject: Cryptography & Cyber Security (EC0716)

Semester: VII (2021)



Subject: Cryptography & Cyber Security (EC0716)



#### Name of Institute: Institute of Technology & Engineering Name of Faculty: Prof.Zalak Patel

## Course code:EC0728

#### **Course name: Robotics**

Pre-requisites: Mathematics, Physics, Programming Skills Credit points: 3 Offered Semester: 7<sup>th</sup>

#### Course coordinator (weeks 01 - 14)

Full name: Prof. Zalak Patel Department with siting location: Electronics & Communication Engineering Telephone: 7878452549

Email: <u>zalakpatel.ec@indusuni.ac.in</u> Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

#### Course lecturer (weeks 01 - 14)

Full name: Prof. Zalak Patel Department with siting location: Electronics & Communication Engineering Telephone: 7878452549 Email: <u>zalakpatel.ec@indusuni.ac.in</u> Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

Students will be contacted throughout the session via mail with important information relating to this course.

#### **Course Objectives**

By participating in and understanding all facets of this course a student will:

- 1. To describe the history and early beginning of robotics.
- 2. Aims to develop the understanding of Robotics Components.
- 3. To apply creative approaches to practical applications, identify technological opportunities in robotics.
- 4. To impart knowledge about the engineering aspects of Robots and their applications.


#### **Course Outcomes (CO)**

At the end of this subject, students should be able to:

1. Demonstrate use of engineering methods and problem solving towards design of the specified robot.

2. Compare and contrast various mechanical systems.

- 3. Describe Robot control & its applications.
- 4. The students will be able to analyse and design robotic structures.

#### **Course Outline**

| Unit<br>No. | Topics  |  |  |  |  |  |  |  |
|-------------|---|--|--|--|--|--|--|--|
| 1           | Introduction- Robot anatomy-Definition, law of robotics, History and characteristics of Robots-precision, accuracy and repeatability.   |  |  |  |  |  |  |  |
|             | Robotic arm – Robot joints and links, Robot classifications, Areas of application, Architecture of robotic systems.   |  |  |  |  |  |  |  |
|             | End effectors - Mechanical grippers-Slider crank mechanism, Screw type,<br>cam type-Magnetic grippers- Vacuum grippers-Air operated grippers-<br>Gripper force analysis-Gripper design-Simple problems  |  |  |  |  |  |  |  |
| 2           | Transformation types - 2D, 3D. Translation- Homogeneous coordinates multiple transformation-Simple problems.  |  |  |  |  |  |  |  |
|             | Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors Robotic vision sensor-Force sensor-Light sensors, Pressure sensors  |  |  |  |  |  |  |  |
|             | Actuators - Specification, principle of operation and areas of application of:<br>Stepper motor, Servo motor and brushless DC motor. Microprocessor<br>control of electric motors, speed control using PWM and direction control<br>using H- Bridge |  |  |  |  |  |  |  |
| 3           | Robotic vision systems- Imaging, Sensing and Digitization, Image processing techniques, Areas of application in robotics.   |  |  |  |  |  |  |  |
|             | Introduction to kinematics- Position and orientation of objects, Rotation,<br>Euler angles, Rigid motion representation using Homogenous<br>Transformation matrix.  |  |  |  |  |  |  |  |
|             | Forward kinematics- Link coordinates, Denavit-Hartenberg Representation,<br>Application of DH convention to different serial kinematic arrangements<br>fitted with spherical wrist.   |  |  |  |  |  |  |  |
|             | Inverse kinematics – General properties of solutions, Kinematic Decoupling,<br>Inverse kinematic solutions for all basic types of three-link robotic arms<br>fitted with a spherical wrist.   |  |  |  |  |  |  |  |



| 4      | Velocity kinematics – Derivation of the Jacobian, Application of v kinematics for serial manipulators, importance of Singularities.   |   |  |  |  |  |  |  |
|--------|---|---|--|--|--|--|--|--|
|        | Manip<br>equat<br>contro<br>contro  | ator Dynamics - Introduction to Legrangian mechanics and Dynamic<br>for 2 Degree of Freedom (DOF) robots, Introduction to position<br>and force control of robotic manipulators,Robot actuation and<br>using PID controllers. |  |  |  |  |  |  |
|        | Programming – Programming methods, Robot language classification,<br>language structure, elements and its functions. Motion, End-effecter<br>sensor commands in VAL programming language. Simple programs.<br>trial applications of Robots in material handling and assembly. Mobile<br>s, Recent developments in Robotics. |   |  |  |  |  |  |  |
| Text   |   | 1. Mikell and Groover, Industrial Robotics – Technology,  |  |  |  |  |  |  |
| books  | :   | Programming and Applications, McGraw Hill, 2/e, 2012.   |  |  |  |  |  |  |
|        |   | 2. Introduction to Robotics by J.J. Craig, Addison-Wesley Publishing  |  |  |  |  |  |  |
|        |   | Company, 1986.  |  |  |  |  |  |  |
|        |   | 3. Saeed B. Niku Introduction to Robotics. Analysis and control,  |  |  |  |  |  |  |
|        |   | applications- Wiley student edition, 2010.  |  |  |  |  |  |  |
|        |   | 4. K.S.FU, R.C. GONZAIEZ, CSG LEE-RODOTICS CONTROL, SENSING, VISION   |  |  |  |  |  |  |
|        |   | & Intelligence, McGraw-Hill.  |  |  |  |  |  |  |
|        |   | δ. Sons 1990  |  |  |  |  |  |  |
|        |   | Bobert L Schilling Fundamentals of Robotics: Analysis & Control   |  |  |  |  |  |  |
| Refere | ence  | Pearson Education. 2000.  |  |  |  |  |  |  |
| Books  | /Note   | 2. Fundamentals of Robotics by D.K. Pratihar, Narosa Publishing   |  |  |  |  |  |  |
| s      |   | House, New-Delhi, 2017.   |  |  |  |  |  |  |
|        |   | 3. Ashitava Ghosal, Robotics, Fundamental concepts and analysis,  |  |  |  |  |  |  |
|        |   | OXFORD University Press, 2006   |  |  |  |  |  |  |
|        |   | 4. S. Sitharama Iyengar, Alberto Elefes-Autonomous Mobile Robots  |  |  |  |  |  |  |
|        |   | Control, Planning & Achitecture, IEEE Computer Society Press  |  |  |  |  |  |  |
|        |   | 5. KIATTER, K.D., CHMIEIEWSKI, I.A, NEGIN, M, RODOTIC Engineering An  |  |  |  |  |  |  |
|        |   | Integrated Approach, PHI, 2007.   |  |  |  |  |  |  |
|        |   | McGraw Hill New Delhi 1994  |  |  |  |  |  |  |
|        |   |   |  |  |  |  |  |  |

### Method of delivery

- 1. Chalk and talk
- 2. PowerPoint Presentations
- 3. Self-study material
- 4. NPTEL notes

#### Study time

3 hours per week Lectures



#### **CO-PO Mapping (PO: Program Outcomes)**

|     | P<br>0<br>1  | РО<br>2      | РО<br>3      | РО<br>4 | РО<br>5      | РО<br>6 | РО<br>7 | PO<br>8 | РО<br>9      | PO1<br>0 | PO1<br>1     | PO1<br>2 |
|-----|--------------|--------------|--------------|---------|--------------|---------|---------|---------|--------------|----------|--------------|----------|
| CO1 | $\checkmark$ | $\checkmark$ | $\checkmark$ |         | $\checkmark$ |         |         |         | $\checkmark$ |          |              |          |
| CO2 | $\checkmark$ | $\checkmark$ | $\checkmark$ |         | $\checkmark$ |         |         |         | $\checkmark$ |          |              |          |
| CO3 | $\checkmark$ | $\checkmark$ | $\checkmark$ |         | $\checkmark$ |         |         |         | $\checkmark$ |          |              |          |
| CO4 | $\checkmark$ | $\checkmark$ | $\checkmark$ |         | $\checkmark$ |         |         |         | $\checkmark$ |          |              |          |
| CO5 | $\checkmark$ | $\checkmark$ | $\checkmark$ |         | $\checkmark$ |         |         |         |              |          | $\checkmark$ |          |

**Blooms Taxonomy and Knowledge retention (For reference)** (Blooms taxonomy has been given for reference)





## **Graduate Qualities and Capabilities covered** (Qualities graduates harness crediting this Course)

| General Graduate Qualities   | Specific Department of<br>Graduate Capabilities    |
|--|--|
| Informed<br>Have a sound knowledge of an area<br>of study or profession and<br>understand its current issues, locally<br>and internationally. Know how to<br>apply this knowledge. Understand<br>how an area of study has developed<br>and how it relates to other areas.  | 1 Professional knowledge,<br>grounding & awareness |
| Independent learners<br>Engage with new ideas and ways of<br>thinking and critically analyze<br>issues. Seek to extend knowledge<br>through ongoing research, enquiry<br>and reflection. Find and evaluate<br>information, using a variety of<br>sources and technologies.<br>Acknowledge the work and ideas of<br>others. | 2 Information literacy, gathering<br>& processing  |
| Problem solvers<br>Take on challenges and<br>opportunities. Apply creative, logical<br>and critical thinking skills to respond<br>effectively. Make and implement<br>decisions. Be flexible, thorough,<br>innovative and aim for high<br>standards.  | 4 Problem solving skills                           |
| Effective communicators  | 5 Written communication                            |
| Articulate ideas and convey them   | 6 Oral communication                               |
| Work collaboratively and engage<br>with people in different settings.<br>Recognize how culture can shape<br>communication.   | 7 Teamwork   |
| <b>Responsible</b><br>Understand how decisions can affect<br>others and make ethically informed<br>choices. Appreciate and respect<br>diversity. Act with integrity as part<br>of local, national, global and<br>professional communities.   | 10 Sustainability, societal & environmental impact |



#### Lecture/tutorial times

(Give lecture times in the format below)

Online class Time Table

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

#### **Details of referencing system to be used in written work**

- 1. Text Books and Reference Books
- 2. Online Resources

#### **Additional Materials**

- 1. <u>https://nptel.ac.in/courses/112/105/112105249/</u>
- 2. <u>http://vlabs.iitkgp.ernet.in/mr/index.html#</u>

#### **ASSESSMENT GUIDELINES**

Your final course mark will be calculated from the following:

- 1. Theory CIE 60 marks:
- a. Midsem exam: 40 Marks
- b. Assignment: 10 Marks
- c. Quiz: 10 Marks

#### SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.



#### **Practical Work Report/Laboratory Report:**

A report on the practical work is due the subsequent week after completion of the class by each group.

#### Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 10 % of the maximum mark per calendar day

#### Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.

#### **Retention of Written Work**

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

#### **University and Faculty Policies**

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

**Plagiarism** - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

#### Do not copy the work of other students.

Do not share your work with other students (except where required for a group activity or assessment)



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# **Course schedule (subject to change)** (Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

|  | Week #  | Topic & contents  | CO<br>Addressed | Teaching<br>Learning<br>Activity<br>(TLA)        |  |  |  |  |  |
|--|---------|---|-----------------|--|--|--|--|--|--|
|  | Weeks 1 | Robot anatomy-<br>Definition, law of<br>robotics, History and<br>characteristics of Robots-<br>precision, accuracy and<br>repeatability.  | CO1, CO3        | Chalk and<br>talk<br>PowerPoint<br>Presentations |  |  |  |  |  |
|  | Weeks 2 | Robotic arm – Robot joints and<br>links, Robot classifications,<br>Areas of application,<br>Architecture of robotic systems   | CO1, CO3        | Chalk and<br>talk<br>PowerPoint<br>Presentations |  |  |  |  |  |
|  | Week 3  | Mechanical grippers-Slider<br>crank mechanism, Screw type,<br>cam type-Magnetic grippers-<br>Vacuum grippers-Air operated<br>grippers-Gripper force analysis-<br>Gripper design-Simple<br>problems. | CO2             | Chalk and<br>talk<br>PowerPoint<br>Presentations |  |  |  |  |  |
|  | Week 4  | Sensors in robot – Touch<br>sensors-Tactile sensor –<br>Proximity and range sensors<br>Robotic vision sensor-Force<br>sensor-Light sensors, Pressure<br>sensors                                     | CO1, CO3        | Chalk and<br>talk<br>PowerPoint<br>Presentations |  |  |  |  |  |
|  | Week 5  | Actuators - Specification,<br>principle of operation and areas<br>of application of: Stepper<br>motor, Servo motor and<br>brushless DC motor.   | CO1, CO3        | Chalk and<br>talk<br>PowerPoint<br>Presentations |  |  |  |  |  |
|  |         |   |                 |  |  |  |  |  |  |
|  | Week 6  | Microprocessor control of<br>electric motors, speed control<br>using PWM and direction<br>control using H- Bridge   | CO3             | Chalk and<br>talk<br>PowerPoint<br>Presentations |  |  |  |  |  |
|  | Week 7  | Robotic vision systems-<br>Imaging, Sensing and<br>Digitization, Image processing<br>techniques, Areas of   | CO3             | Chalk and<br>talk<br>PowerPoint<br>Presentations |  |  |  |  |  |

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|---------|---|-----|--|
|         | application in robotics.  |     |  |
| Week 8  | Introduction to kinematics-<br>Position and orientation of<br>objects, Rotation, Euler angles,<br>Rigid motion representation<br>using Homogenous<br>Transformation matrix.   | CO2 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 9  | Forward kinematics- Link<br>coordinates, Denavit-<br>Hartenberg Representation,<br>Application of DH convention to<br>different serial kinematic<br>arrangements fitted with<br>spherical wrist.  | CO2 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 10 | Inverse kinematics – General<br>properties of solutions,<br>Kinematic Decoupling, Inverse<br>kinematic solutions for all basic<br>types of three-link robotic arms<br>fitted with a spherical wrist.  | CO2 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 11 | Velocity kinematics –<br>Derivation of the Jacobian,<br>Application of velocity<br>kinematics for serial<br>manipulators, importance of<br>Singularities.   | CO2 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 12 | Manipulator Dynamics -<br>Introduction to Legrangian<br>mechanics and Dynamic<br>equation for 2 Degree of<br>Freedom (DOF) robots,<br>Introduction to position control<br>and force control of robotic<br>manipulators,Robot actuation<br>and control using PID<br>controllers. | CO2 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 13 | Robot Programming –<br>Programming methods, Robot<br>language classification, Robot<br>language structure, elements<br>and its functions. Motion, End-<br>effecter and Sensor commands<br>in VAL programming language.  | C04 | Chalk and<br>talk<br>PowerPoint<br>Presentations |
| Week 14 | Simple programs. Industrial<br>applications of Robots in<br>material handling and<br>assembly. Mobile robots,<br>Recent developments in   | CO4 |  |





**Program map for B.Tech (Electronics & Communication Engineering)** 

