Proposed Syllabus for M.Sc. (Computer Science) Semester 3 and Semester 4
(Affiliated Colleges to University of Pune)

To be implemented from Academic year 2012-2013

Semester 3

CS-301(NEW): Software Metrics & Project Management

CS-302(NEW): Mobile Computing

CS-303(NEW): Soft Computing

CS-304(NEW): Elective Course (Departmental)

CS-305(NEW): Laboratory course (Departmental)

Semester 4

CS-401(NEW): Full Time "Industrial Training Project"

CS-301(NEW): Software Metrics & Project Management

1. What is a Project? What is Project management? Project phases and project life cycle, organizational structure, Qualities of Project Manager. [4]
2. Project Management Components. Project Integration Management-Project plan development and execution, change controls, configuration management.   [6]
3. Scope Management-Strategic planning ,scope planning, definition ,verification and control.   [4]
4. Time management- Activity planning, schedule development and control. [2]
5. Cost Management- Cost estimation and Control.   [2]
6. Quality Management- Quality planning and assurance.   [2]
7. Human Resource Management- Organizational planning, staff acquisition. [2]
8. Communication Management-Information distribution , reporting. [2]
9. Risk Management-Risk identification, Quantification and control.   [2]
10. Procurement Management- Solicitation, contract administration.   [2]
11. Software Metrics- The scope of software metrics, software metrics data collection, analyzing software data, measuring size, structure, external attributes. [6]
12. Software Reliability- Measurement and prediction, resource measurement, productivity, teams and tools.   [6]
13. Planning a measurement program. What is metrics plan?: Developing goals, questions and metrics. Where and When: Mapping measures to activities. How: Measurement tools. Who: Measurers, analyst, tools revision plans.   [4]
14. Quality Standards – CMM, PSP/TSP   [4]

References
1. Information Technology Project Management, 6th Edition Kathy Schwalbe ISBN-13: 9781111221751 , Cenage Learning
2. Software Metrics: A rigorous and Practical Approach by Norman E. Fenton and Shari Lawrence Pfleeger, International Thomson Computer Press
3. Software Engineering: A Practioner's Approach by Roger S. Pressman ISBN: 9780071267823
4. Practical Software Metrics for Project Management and Process Improvement Robert B. Grady, Prentice hall, ISBN : 9780137203840

CS-302(NEW): MOBILE COMPUTING

Prerequisites

- Concepts of Data communication
- Concepts of Networking
- Conversant with OS internals
- Java programming
- Brief History of wireless communication

Objectives

- To familiarize the students with the technology behind mobile communication
- Understand the GSM architecture and services provided
- Understand the issues relating to Wireless mobile applications
- Understand the architecture of J2ME and Android Operating System.
- Develop simple mobile applications.

1. Introduction to Mobile Computing   **Lectures 2**
  i.   Introduction and need for Mobile computing
  ii.   Mobility and portability
  iii. Mobile and Wireless devices
  iv.   Applications
  v.   Brief History of wireless communication

- *Mobile Comm. By Jochen Schiller*

2. Wireless Transmission   **Lectures 3**
  i.   General Concepts of multiplexing and modulation
  ii.   Spread Spectrum
  iii. Cellular Systems

- *Mobile Comm. By Jochen Schiller*

3. Medium Access Control Layer   **Lectures 4**
  i.   Why specialized MAC?
        a.   hidden and exposed terminals
        b.   near and far terminals
  ii.   General Concepts and comparison of SDMA, FDMA, TDMA , CDMA

- *Mobile Comm. By Jochen Sciller*

4. Mobile IP   **Lectures 9**

    i. Goals, assumptions and requirements
    ii. Entities and terminologies
    iii. Agent Discovery
    iv. Registration
    v. Tunneling and encapsulation
    vi. Reverse Tunneling
    vii. IPv6
    viii. IP micro-mobility support – Cellular IP, Hawaii, Hierarchical, mobile IPv6
    ix. Mobile Routing :
- Destination sequence distance Vector, Dynamic Source Routing,
- Alternative Metrics, Adhoc Routing Protocols -Flat, Hierarchical,
- Geographic-position-assisted

- *Mobile Comm. By Jochen Schiller*

5. Mobile TCP   **Lectures 5**

    i. Traditional TCP
       ➢ Congestion Control, Slow start, Fast retransmit / Fast recovery
       ➢ Implications on mobility
    ii. Classical TCP improvements
       ➢ Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit / Fast recovery, Transmission / Timeout freezing, Selective Retransmission, Transaction oriented TCP
    iii. TCP over 2.5/3G wireless networks

- *Mobile Communications By Jochen Schiller*

6. GSM   **Lectures 9**

    i. Mobile Services (Bearer, Tele-and-supplementary services)
    ii. System Architecture
       ➢ Radio subsystem
       ➢ Network and switching subsystem
       ➢ Operation subsystem
    iii. Protocols
       ➢ Localization and calling
       ➢ Handover
    iv. Value Added Services
       ➢ SMS: Architecture, Mobile Originated and Mobile Terminated procedures
       ➢ Cell Broadcast Service: Architecture, Message Transfer Procedure
       ➢ MMS: Architecture, Protocol framework, Message Transfer Procedure
       ➢ Location Services: Logical Reference Model, Control Procedures, Network Architecture, determination of Location Information, Location based services
  v. GPRS

- *Mobile Communication. By Jochen Schiller*
- *2G Mobile Networks: GSM and HSCSD By Nishit Narang and Sumit Kasera*

7. Introduction to 3G mobile networks   **Lectures 4**
i. UMTS
        System architecture, radio interface(Pg 163,164)
ii. UTRAN
        Architecture, Functions of RNC, Core network
iii. Handover
        Hard and soft handover

- *Mobile Communication. By Jochen Schiller*

8. Wireless Application Protocol   **Lectures: 6**
i. Architecture
ii. Wireless datagram protocol
iii. Wireless transport layer security
iv. Wireless transaction protocol
v. Wireless session protocol
vi. Wireless application environment
vii. WAP Push Architecture, protocols

- *Mobile Communications by Jochen Schiller*

9. Introduction to J2ME   **Lectures 3**
i. J2ME Architecture
ii. CLDC, CDC
iii. J2ME Profiles
iv. MIDlets, lifecycle of MIDlet
v. Simple J2ME MIDlet.

Any J2ME book / online resources

10. Introduction to Android Operating System   **Lectures 3**
i. Overview and evolution of Android
ii. Features of Android
iii. Android architecture
iv. Components of an Android Application, Manifest file
v. Android Activity and Service Lifecycle

Any Android book / online resources

Reference Books

1. Learning Android Game Programming: A Hands-On Guide to Building Your First Android Game by Rick Rogers, addison-wesley professional, ISBN: 9780321769626
2. Mobile Communications Jochen Schiller, Pearson Education, 2nd Edition, ISBN : 9780321123817

3. Pervasive Computing: Technology and Architecture of Mobile Internet Applications-Jochen Burkhardt, Dr. Horst Henn, Steffen Hepper, Klaus Rintdorff, Thomas Schack , Pearson Education ISBN 9788177582802
4. Beginning Android Application Development by Wei-Meng Lee Wiley India ISBN:9788126531066
5. Mobile Computing: Implementing Pervasive Information and Communications Technologies by Shambhu Upadhyaya, Kevin Kwiat, Abhijit Chaudhury, Springer ISBN:9781402071379
6. Wireless Java Programming with J2ME - Yu Feng and Dr, Jun Zhu , Techmedia Publications, 1st edition
7. Complete Reference J2ME , by James Keogh ISBN: 978-0072227109
8. Mobile Networks GSM and HSCSD- Nishit Narang, Sumit Kasera, TataMcGrawHill
9. Mobile Computing: Technology, Applications, and Service Creation by Asoke K. Talukder, Roopa R. Yavagal, ISBN : 9780071477338
10. Beginning Android 3 by Mark Murphy APress , ISBN 9788132203568
11. Beginning Android - Mark Murphy, Apress ISBN 9781430224198
12. Android Application Development: Programming with the Google SDK by Rick Rogers, John Lombardo, Zigurd Mednieks, O'reilly mediaISBN:9780596521479
13. The Android Developer's Cookbook: Building Applications with the Android SDKby James Steele,Nelson To, Aaddison-wesley professional, ISBN: 9780321741233
14. Beginning Android Application Development by Wei-Meng Lee, Wiley India pvt ltd, ISBN:9788126531066
15. The Android Developers Guide [http://developer.android.com/guide/index.html]

<center>**CS-303(NEW): Soft Computing**</center>

Objective: To understand the concepts of how an intelligent system work and its brief development process

Description: Intelligent systems can function as intelligent assistants, augmenting or supplementing human expertise while increasing productivity. This course exposes learners to Neural Network, Fuzzy Logic and Genetic Algorithms, which are the major building blocks of Intelligent Systems.

1. **Classical Sets and Fuzzy Sets and Fuzzy relations**   [5]
   Operations on Classical sets, properties of classical sets, Fuzzy set operations, properties of fuzzy sets, cardinality, operations, and properties of fuzzy relations.
2. **Membership functions** [4]
   Features of membership functions, standard forms and boundaries, fuzzification, Inference
3. **Fuzzy to Crisp conversions**   [4]
   Lambda Cuts for fuzzy sets, fuzzy Relations, Defuzzification methods,
4. **Classical Logic and Fuzzy Logic**   [3]
   Classical predicate logic, Fuzzy Logic, Approximate reasoning and Fuzzy Implication
5. **Fuzzy Rule based Systems**   [4]
   Linguistic Hedges, Fuzzy Rule based system – Aggregation of fuzzy Rules, Fuzzy Inference System with MATLAB,
6. **Applications of Fuzzy Logic** [3]
   How Fuzzy Logic is applied in Home Appliances, General Fuzzy Logic controllers, Basic Medical Diagnostic systems and Weather forecasting
7. **Introduction to Neural Networks**   [4]
   Advent of Modern Neuroscience, Classical AI and Neural Networks, Hybrid Intelligent Systems, Biological Neurons
8. **Artificial Neurons, Neural Networks and Architectures**   [4]
   Neuron abstraction, Neuron signal functions, Architectures: feedforward and feedback Salient properties and application domains
9. **Perceptrons and LMS**   [8]
   Learning and memory, From synopses to behaviour : The case of Aplysia, Learning Algorithms, Error correction and gradient descent rules, The learning objectives for TLNs, Pattern space and weight space, Perceptron learning algorithm, Perceptron convergence algorithm, Perceptron learning and Non-separable sets, alpha-Least Mean Square Learning, MSE Error Surface and its Geometry, Steepest Descent Search with Exact Gradient Information, Mue-LMS: Approximate Gradient Descent, Backpropagation Learning algorithm
10. **Applications of Neural Networks**   [3]
    Pattern Recognition and classification

11. **Genetic Algorithms (GA)**   [4]
    Introduction to GA. Robustness of Traditional Optimization and search methods. How are Genetic Algorithms different from Traditional Methods?
12. **Applications of Genetic Algorithm**   [4]
    GA based clustering Algorithm, Image processing and pattern Recognition

Reference Books
- Principles Of Soft Computing (With CD)by S. N. Sivanandam,S. N. Deepa, Wiley india, ISBN:9788126527410
- Fuzzy Logic: With Engineering Applications by Timothy J Ross, Wiley India, ISBN:9788126513376
- Neural Networks: A Classroom Approach,1/e by Kumar Satish, TMH, ISBN:9780070482920
- Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg, Pearson Education, ISBN:9788177588293
- AN INTRODUCATION TO FUZZY LOGIC AND FUZZY SETS by Buckley James J., Springer ISBN:9788181287878
- Neural Networks: An Introduction by Berndt Muller, B. Muller, Springer, ISBN: 9783540602071
- Introduction to Genetic Algorithms by S. N. Sivanandam, S. N. Deepa. Springer, ISBN: 9783540731894

CS-304(New): Elective Course

Please note that, one elective from the following list to be opted for each of the semesters 2nd and 3rd (CS-204 in semester two and CS-304 in semester three respectively) according to prerequisite conditions (if any).

List of Elective Courses

1. Advanced Algorithms
2. Functional Programming
3. Linux Kernel Programming and Introduction to Device Drivers
4. Natural Language Processing
5. Program Analysis
6. DOT NET
7. Information Systems Security
8. Software Architecture and Design Patterns
9. Software Testing Tools & Methodologies
10. Modeling and Simulations
11. Embedded System Programming
12. Language Processors
13. Artificial Intelligence

CS-305(NEW): Lab Course (Departmental)

Distribution of Marks for Assignments

Course Code	Paper Title	Marks
CS-301(NEW)	Software Metrics & Project Management	10
CS-302(NEW)	Mobile Computing	15
CS-303(NEW)	Soft Computing	15
CS-304(NEW)	Elective Course(Departmental)	10
Total Marks		50

➢ Project for 50 Marks

Student can undertake a project on any platform using any technology. However, if a student chooses to use mobile technology then the following guidelines are to be used.

It is expected (not compulsory) that M.Sc. Sem III students will to do a project in Mobile Computing so that they will have enough hands on experience of programming under mobile computing environment . If a student wishes to do so, the project may to be done in J2ME and the student is expected to use following features of J2ME:
- ❖ Persistent storage
- ❖ Networking (if required)
- ❖ Messaging APIs (if required)
- ❖ Web Server (if required)
- ❖ Email Servers

List of Projects for Reference:

1. Tax calculation and planning by considering all possible investment options and special relaxations

2. Marathi Calendar/Calendar with all religious and festival events etc. (Standard English Calendar is not allowed)

3. General Planner

4. Personal Insurance Planner (policy details with remainders for premiums)

5. Small text file editor

6. Mobile chatting (using chat server running on normal PC)

7. Group chatting using Bluetooth (without server)

8. Games (single player/multiplayer)

9. Application to operate PPT presentation using mobile phone

10. Mobile phone based attendance system

11. Uploading/Downloading contact list from email server such as gmail.com, rediffmail.com etc.

12. Downloading notices, list of assignments, exam schedule on mobile phone of student using server present in college laboratory.

NOTE: Please discuss feasibility of mobile application with your guide before choosing a topic. To develop and test mobile applications appropriate resources must be available. College will only provide PC and if possible mobile phones. Students have to arrange for additional resources as per the requirements of their Project

➢ **Assignments**

15+15+15 marks respectively for the University courses (CS-301(NEW), CS-302(NEW), CS-303(NEW)) and 5 marks for an active participation in the seminar by an expert on emerging technologies

Assignments on CS-301(NEW)

Any two aspects of an application system from the following list should be carried out by the student as his assignment for 15 marks
- Description of the system (covering major inputs, outputs, overall activity flow of the system etc.)
- Project Charter
- Scope Statement
- Work Breakdown Structure (upto level 3)
- Cost Appropriation Structure
- Overall Time Schedule
- Role of Project Manager in that specific System
- Roles & Responsibility Matrix Preparation

The above assignment can be on any one application system. The sample list of the same is as follows.
- Library System (College Library or Public Library)
- College Admission System
- College/University Examination System
- Sales System

- Purchase System
- Production Management System
- Inventory System
- Recruitment System of a Company
- Salary Processing System
- Transaction Processing System in organizations like banks, LIC, Financial Institutions etc.
- Any Specific Events Management System (like IPL tournament, Cricket/football World Cup etc, Adhar Card issuing system)
- Local Transport Route Scheduling System

Assignments on CS-302(NEW)

Implementation guidelines

- Every student should do **at least one** assignment for this subject, either using J2ME or Android.
- The assignment should be done individually.
- The total weightage for the assignment is **15 marks**.

Sample list of Assignments:

1. Create TODO list with alarm functionality
2. Appointment / event scheduler
3. Timetable manager with alerts
4. Simple calculator
5. Secure sms
6. Secure phonebook
7. Mobile Dictionary
8. Information retrieval Applications : Stock quotes, Cricket score, daily horoscope etc.
9. Games (word games, puzzles, tic-tac-toe, Sudoku etc.)
10. Mobile Quiz
11. Personal expense manager
12. Barcode reader
13. Vehicle details and average/mileage calculation app.
14. Secure Password and Account information manager
15. Music player application with play, pause and resume functionality.
16. Image viewer to list and view the images.
17. Video Player application to play MPEG files.
18. Integration with Google Apps: Google Maps, Docs, Calender etc.
19. Simple Applications using GPS
20. Datebook with important dates, birthdays, holidays, events etc.
21. Create Stopwatch app with the timer functionality.

22. Unit Converter Apps
23. Body Mass Index Application
24. Recipe App with facilities to list, view, add/delete recipes
25. Google map application with the facility to show important cities Annotation on Map.
26. Facebook App to share text, images on user's Wall.
27. Twitter App to tweet from your phone.
28. Interfacing apps to control electronic circuits (ex: temperature controller from mobile device, LED/LCD display)
29. PC-Mobile Communication Apps (Desktop viewer, LAN management, PC Hardware-Software information, LAN user list retriever, PC controlling etc.)
30. Bluetooth based applications: sending message, files etc.

Assignments on CS-303(NEW)

Fuzzy Logic Assignments on following topics :

Max-Min Composition, Max Product Composition, Zadeh's extension principle, Linguistic Hedges, Alpha Cut

Solve the following and write software –programs for the above methods.

Assignment No. 303_FL_1
The task of identifying images in an overhead reconnaissance photograph is imprecise. You are now ready to design computer software to do image processing to locate objects within a scene. Define two fuzzy sets representing a car and a truck image.

Fuzzy set for Car = 0.5/truck + 0.4/motorcycle + 0.3/boat + 0.9/car + 0.9/house

Fuzzy set for Truck = 1/truck + 0.1/motorcycle + 0.4/boat + 0.4/car + 0.2/house

Find the following:
       a) Car $\cap$ Truck
       b) Car $\cup$ Truck

Assignment No. 303_FL_2

We need a circuit that can detect the AC line frequency, to determine whether the camera should implement the European PAL, video standard (for 50 –Hz systems) or the U.S NTSC video standard (for 60 Hz systems)
Fuzzy set A is 'about 60 Hz" and Fuzzy set B is "about 50 Hz".
The universe for both of these variables – 0 to infinite frequency. Continuous, triangular membership function to be used, symmetric about the prototypical value.
       A has a prototypical value of 60Hz
       B has a prototypical value of 50Hz
       Base width for both fuzzy set A and B 16 Hz

For fuzzy set A, $\mu_A(x) = |60-x|/8 + 1$

For fuzzy set B, $\mu_B(x) = |50-x|/8 + 1$

Assignment No. 303_FL_3

There are four groups of M.Sc. students at the University. A fuzzy tolerance relation R is produced by the domain experts according to the level of academic preparations of these students. If α cut levels and find classes into which these four groups can be classified.

$$
\text{Fuzzy R} = \begin{array}{cccc}
1 & 0.8 & 0.3 & 0.7 \\
0.8 & 1 & 0.9 & 0.1 \\
0.3 & 0.9 & 1 & 0.6 \\
0.7 & 0.1 & 0.6 & 1
\end{array}
$$

[Explain the procedure clearly and assumptions made, if any]

Assignment No. 303_FL_4

The relationship between temperature and maximum operating Frequency R depends on various factors for given electronic circuit. Let Fuzzy T be a temperature fuzzy set (in degrees Fahrenheit) and Fuzzy F represent a frequency fuzzy set (in MHz) on the following universe of discourse:

T = {-100, -50, 0, 50, 100} and F = {8, 16, 25, 33}

Suppose a Cartesian product between Fuzzy T and Fuzzy F is formed that results in the following relation.

	-100	-50	0	50	100
8	0.2	0.5	0.7	1	0.9
16	0.3	0.5	0.7	1	0.8
25	0.4	0.6	0.8	0.9	0.4
33	0.9	1	0.8	0.6	0.4

R =

The reliability of the electronic circuit is related to the maximum operating temperature. Such a relation S can be expressed as a Cartesian product between the reliability index M = {1, 2, 4, 8, 16} (in dimensionless units) and the temperature, as in the following example.

	1	2	4	8	16
-100	1	0.8	0.6	0.3	0.1
-50	0.7	1	0.7	0.5	0.4
0	0.5	0.6	1	0.8	0.8
50	0.3	0.4	0.6	1	0.9
100	0.9	0.3	0.5	0.7	1

S =

Composition can be performed on any two or more relations with compatible row column consistency. To find a relationship between frequency and the reliability index, use Max- min composition and Max –product composition

Assignment No. 303_FL_5

Consider the following function:

$$Y = f(x) = (x - 3)^2 = x^2 - 6x + 11$$

The fuzzy integer number Around A for X universe is given as below:
Around A = {0.3/2 + 0.6/3 +1/4 +0.6/5 +0.3/6} where + denotes union. Explain and apply Zadeh's extension principle.

Assignment No. 303_FL_6

In the field of computer networking there is an imprecise relationship between the level of use of a network communication bandwidth and the latency experienced in peer – to – peer communications.   Let X be a fuzzy set of use levels (in terms of the percentage of full band width used) and Y be a fuzzy set of latencies (in milliseconds)

X = {0.2 / 10 + 0.5 / 20 +0.8 /40 +1.0 /60 + 0.6 /80 + 0.1 / 100}
Y = {0.3/ 0.5 + 0.6 / 1 + 0.9 /1.5 +1.0 /4 + 0.6 / 8 + 0.3 / 20}

You have been given a second fuzzy set of bandwidth usage -

Z = {0.3 /10 + 0.6 /20 + 0.7 /40 + 0.9 / 60 + 1 / 80 + 0.5 / 100}
Compute Max-Min Composition
Compute Max-Product

Assignment No. 303_FL_7

A certain Software Developer Test his products for User friendliness by trying their programs out on new users. The test participants are given a user manual and asked to perform a task with the software. Meanwhile the developer watches the Users reaction as they use the software. The developer keeps a record of each User's Performance. Counting the number of times each User looks at the manual and recording each Users opinion of how User friendly the software was. The developer then creates two fuzzy variables, User friendly and easy to learn relating the User's reactions to how many times they had to look at the manual

User friendly = {1/0 + 0.8/1 + 0.65/2 + 0.4/3 + 0.15/4 + 0.05/5}
Easy to Learn = {1/0 + 0.9/1 + 0.75/2 + 0.6/3 + 0.3/4 + 0.1/5}
On the basis of the Observation find the Membership functions for the following User friendly but not very User friendly User friendly or easy to learn

Neural Network Assignments (On Perceptron)

Assignment No. 303_NN_1: Create a 2-class problem on 2-dimensional data. Generate 500 examples (approximately equal number for each class) with attributes from [0,1]. Plot the data points

Assignment No. 303_NN_2: Create a NN to classify some data into one of two classes E.g: Classify Soft drinks produced by certain Companies as 'Good' or 'Bad' based on certain attributes Like – taste, effervesce, mouth feel, color

Genetic Algorithms Assignment (On Crossover and Mutation)
Assignment No. 303_GA_1: The Knapsack Problem

The goal of this assignment is to write a genetic algorithm that solves the Knapsack Problem. Briefly stated, the Knapsack Problem goes like this: You have a collection of N objects of different weights, w_1, w_2, …, w_n, and different values, v_1, v_2, …, v_n, and a knapsack that can only hold a certain maximum combined weight W. You would like to get a set of objects of maximal value into the knapsack. As a search problem, the knapsack problem turns out to be intractable – there is no way to search that is efficient, reducing the search to an exhaustive check of all possible combinations of objects, and the time to solve it grows exponentially with the number of objects. As a genetic algorithm, however, solutions that come extremely close to the maximum, while not guaranteed to actually be the maximum, can be found very quickly.
Write a GENETIC ALGORITHM that solves the Knapsack problem with parameters:
(knapsack NumIterations ObjectList MaxWeight PopulationSize MutationPct)

Your program will start by creating PopulationSize random members of the population (including a computation of the fitness function for each one). It will then loop iteratively NumIterations times, performing the following functions:
- Randomly select a pair of parents to breed
- Pick a random spot for crossover, and breed two new children (with fitness computed)
- Randomly decide whether to mutate based on MutationPct, and if so, mutate one gene
- Kill off the two weakest members of the population, to keep the size constant

The genome can be simply a list of 1's and 0's, indicating whether each element of ObjectList either is or is not in the knapsack. Store the fitness value. The fitness function is the total value of the objects in the knapsack, unless the weight of the objects would be higher than MaxWeight, in which case the fitness is 0 (or at any rate, smaller than any legitimate non-overweight knapsack). Typically the overweight knapsacks will disappear from your population very quickly). Your program should end by reporting the best remaining member of the population at the end of the run, along with the actual weight and value of that member.

Example:

Name	Weight	Value
A	45	3
B	40	5
C	50	8
D	90	10

And a knapsack can support a maximum weight of 100 pounds.

Let a genome be a pair showing the fitness value and then a list of 0's and 1's showing whether each item is in the knapsack. Some of the genomes that can be randomly generated along with their fitness values:

(3 (1 0 0 0)) [A is in the knapsack; total value is 3]
(8 (1 1 0 0)) [A and B are in the knapsack; total value is 8]
(0 (1 1 1 1)) [A, B, C, and D are all in; fitness value is 0 because the bag is overweight.]

If the first and third is picked to cross over, and if we randomly cross them over starting at the third item, your two new child genomes would be
(0 (1 0 1 1)) and (8 (1 1 0 0))
If we then randomly chose to mutate the last gene of the first child, it would turn into (11 (1 0 1 0)) [A and C are in the knapsack; total value is 11] at which point, if the maximum population size was 3, we would kill off the members valued at 0 and 3, keeping the other three (even though two of them are the same). Then repeat the breeding, mutation, and death cycle until you had gone through the specified number of iterations.

Period – Minimum 4 months

0. There will be a teacher coordinator for a group of students. A teacher coordinator will take care of joining letters from students along with other necessary submission listed below.

1. A student will have to submit 2 reports during the period of ITP to the Department of the college.

2. After the completion of the ITP, a student will have to submit a synopsis along with the project completion certificate from the respective industry/research institute /educational institute.

3. A student will submit one hard copy (Student Copy) and a soft copy's (preferably 2 CDs) of the work carried out towards ITP.

4. The project will be graded by the experts (One internal examiner, one external examiner(academic expert) and one industrial expert) as follows:

O – 75 and above	**C**– 50 and above	
A – 65 and above	**D**– 45 and above	**F**- A student will have to carry out project once again for a complete semester
B – 55 and above	**E**– 40 and above	

Important Note: A student can complete ITP with a research project of a teacher / an expert funded by the University of Pune/ a funding agency.