UGC Guidelines for Choice Based Credit System

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Preamble

• The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country.
  – innovation and improvements in curriculum,
  – teaching-learning process,
  – examination and evaluation systems

• The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system.
Due to lot of diversity in the system of higher education,
  - there are multiple approaches followed by universities towards examination, evaluation and grading system

HEIs must have flexibility and freedom in designing the examination and evaluation methods
  - that best fits the curriculum, syllabi and teaching-learning methods

There is a need to devise a sensible system for awarding the grades based on the performance of students
  - Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both.
  - The conversion from marks to letter grades and the letter grades used vary widely across the HEIs in the country
  - This creates difficulty for the academia and the employers to understand and infer the performance of the students graduating from different universities and colleges based on grades.
the Grading System

• The grading system is
  – considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad.

• So it is desirable to introduce
  – uniform grading system.

• This will facilitate student mobility
  – across institutions within and across countries and
  – also enable potential employers to assess the performance of students.
Applicability of the Grading System

• all undergraduate and
• postgraduate level
• degree, diploma and certificate programmes
Definitions of Key Words

• **Academic Year:**
  – Two consecutive (one odd + one even) semesters

• **Choice Based Credit System (CBCS):**
  – The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses)

• **Course:**
  – Usually referred to, as ‘papers’ is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/ laboratory work/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars/ term papers/ assignments/ presentations/ self-study etc. or a combination of some of these.

• **Credit Based Semester System (CBSS):**
  – Under the CBSS, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be completed by the students.
Definitions of Key Words

• **Credit Point:**
  - the product of grade point and number of credits for a course

• **Credit:**
  - A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.

• **Cumulative Grade Point Average (CGPA):**
  - It is a measure of overall cumulative performance of a student over all semesters.

• **Grade Point:**
  - It is a numerical weight allotted to each letter grade on a 10-point scale.

• **Letter Grade:**
  - It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.

• **Programme:**
  - An educational programme leading to award of a Degree, diploma or certificate.

• **Semester Grade Point Average (SGPA):**
  - It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

• **Semester:**
  - Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be scheduled from July to December and even semester from January to June.

• **Transcript or Grade Card or Certificate:**
  - Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.
Semester System and Choice Based Credit System

- The Indian Higher Education Institutions have been moving from the conventional annual system to semester system.
  - Currently many of the institutions have already introduced the choice based credit system.

- The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning.

- The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching.

- The choice based credit system provides a ‘cafeteria’ type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

- It is desirable that the HEIs move to CBCS and implement the grading system.

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Types of Courses

• Courses in a programme may be of three kinds: Core, Elective and Foundation

• **Core Course:**
  – Compulsorily
  – a core requirement to complete the requirement of a programme

• **Elective Course:**
  – Elective course is a course which can be chosen from a pool of papers. It may be:
    • Supportive to the discipline of study
    • Providing an expanded scope
    • Enabling an exposure to some other discipline/ domain
    • Nurturing student’s proficiency/ skill.

• **Foundation Course:**
  – Compulsory Foundation
    • based upon the content
  – Elective foundation
    • value-based
Examination and Assessment

• There is a marked variation across
  – the colleges and universities in the number of grades,
  – grade points,
  – letter grades used,
  – which creates difficulties in comparing students across the institutions.

• **Letter Grades and Grade Points:**
  – Two methods - relative grading or absolute grading -
  – The relative grading
    • based on the distribution (usually normal distribution) of marks
  – The absolute grading
    • based on pre-determined class intervals.

• The UGC recommends a 10-point grading system with the following letter grades as given below:
## 10-point grading system

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>O (Outstanding)</td>
<td>10</td>
</tr>
<tr>
<td>A+ (Excellent)</td>
<td>9</td>
</tr>
<tr>
<td>A (Very Good)</td>
<td>8</td>
</tr>
<tr>
<td>B+ (Good)</td>
<td>7</td>
</tr>
<tr>
<td>B (Above Average)</td>
<td>6</td>
</tr>
<tr>
<td>C (Average)</td>
<td>5</td>
</tr>
<tr>
<td>P (Pass)</td>
<td>4</td>
</tr>
<tr>
<td>F (Fail)</td>
<td>0</td>
</tr>
<tr>
<td>Ab (Absent)</td>
<td>0</td>
</tr>
</tbody>
</table>
Examination and Assessment Contd..

- A student obtaining Grade F
  - shall be considered failed and will be required to reappear in the examination.
- For non-credit courses
  - ‘Satisfactory’ or ‘Unsatisfactory’ shall be indicated
  - instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.
- The Universities can decide on the grade or percentage of marks required to pass in a course
- The statutory requirement for eligibility to enter as assistant professor in colleges and universities in the disciplines of arts, science, commerce etc., is a minimum average mark of 50% and 55% in relevant postgraduate degree respectively for reserved and general category. Hence, it is recommended that the cut-off marks for grade B shall not be less than 50% and for grade B+, it should not be less than 55%.
Fairness in Assessment

- at least 50% of core courses
  - question papers will be set as well as assessed by external examiners
- practical component
  - half of the examiners in the team should be invited from outside the university conducting examination
- project reports / thesis / dissertation etc
  - by internal as well as external examiners
Semester Grade Point Average (SGPA)

- is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student.

\[
SGPA\ (S_i) = \frac{\sum (C_i \times G_i)}{\sum C_i}
\]

- where \( C_i \) is the number of credits of the \( i \)th course and \( G_i \) is the grade point scored by the student in the \( i \)th course.
Cumulative Grade Point Average (CGPA)

- The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

\[
\text{CGPA} = \frac{\sum (C_i \times S_i)}{\sum C_i}
\]

- where \(S_i\) is the SGPA of the \(i\)th semester and \(C_i\) is the total number of credits in that semester.
- The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.
Illustration of Computation of SGPA and CGPA and Format for Transcripts

i. Computation of SGPA and CGPA

*Illustration for SGPA*

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
<th>Grade letter</th>
<th>Grade point</th>
<th>Credit Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course 1</td>
<td>3</td>
<td>A</td>
<td>8</td>
<td>3 x 8 = 24</td>
</tr>
<tr>
<td>Course 2</td>
<td>4</td>
<td>B+</td>
<td>7</td>
<td>4 x 7 = 28</td>
</tr>
<tr>
<td>Course 3</td>
<td>3</td>
<td>B</td>
<td>6</td>
<td>3 x 6 = 18</td>
</tr>
<tr>
<td>Course 4</td>
<td>3</td>
<td>O</td>
<td>10</td>
<td>3 x 10 = 30</td>
</tr>
<tr>
<td>Course 5</td>
<td>3</td>
<td>C</td>
<td>5</td>
<td>3 x 5 = 15</td>
</tr>
<tr>
<td>Course 6</td>
<td>4</td>
<td>B</td>
<td>6</td>
<td>4 x 6 = 24</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td></td>
<td></td>
<td>139</td>
</tr>
</tbody>
</table>

Thus, **SGPA = 139/20 = 6.95**
ii. Transcript (Format): Based on the above recommendations on Letter grades, grade points and SGPA and CCPA, the HEIs may issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.
Challenges

- Curriculum Design
- Transfer of mobility students
- Time Frame
- Repetition of Grades
- Conversion of Grades
- Distance Learning
- On-Demand Course Curriculum
In view of getting a complete picture of the student's learning, assessment should focus on the learner ability to:

- Learn and acquire desired skills related to different subject areas, Acquire a level of achievement in different subject areas in the requisite measure
- Develop student's individual skills, interests, attitudes and motivation
- Understand and lead a healthy and productive life
- Monitor the changes taking place in student's learning, behavior and progress over a period of time
- Respond to different situations and opportunities both in and out of school
- Apply what is learnt in a variety of environment, circumstances and situations
- Work independently, collaboratively and harmoniously,
- Analyze and evaluate
- Be aware of social and environmental issues
- Participate in social and environmental projects
- Retain what is learned over a period of time
Steps to Be Followed For Implementation of Choice Based Credit System for All Non Agricultural State Universities of Maharashtra

(Academic Year 2015-16)

• Initiation of Process by
  – Awareness of CBCS to the principal stakeholders (University / College / Institute and Students), Involvement and Suggestion for implementation.
    • Awareness Program : Training Programs at Regional and State Level for coordinator representing organization/ institute
  – Design of Uniform CBCS based scheme for all universities
    • Uniform Course Structure and Evaluation Pattern at UG and PG Level in light of UGC and State Govt. Norms
    • Mechanism of Credit Transfer within University, Inter-University offering Uniform CBCS pattern.
    • Interdisciplinary learning opportunity for student via Bridge Course, Service Course.
- Approval for Uniform CBCS based curriculum for all universities
  - Uniform CBCS Pattern has to be approved through all concern statutory authorities (Board of Studies, Faculties, Academic Council etc.) of respective universities.
  - All University has to prepare the detailed proposal containing Structure, Pattern, Evaluation scheme in light of Uniform CBCS pattern for Consent of Hon’ble Chancellor

- Implementation of Uniform CBCS at all Universities of Maharashtra
Choice Based Credit System (CBCS)

Initiative

By

Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad

www.bamu.net
• Provides Flexibility to make system more responsive to the changing needs of students.

• Provides greater freedom to student to determine their own pace of study.

• Offers Continuous Comprehensive Evaluation of student.

• System Facilitates the transfer of credit
Admission and Promotion

- Admission to the course by CET (Common Entrance Test)

- Eligibility For the Course: As per university norms and qualifying examination

- **Rule for Promotion**: The candidate who has obtained at least D Grades in all courses [Inclusive of Core and Elective] of First Semester and obtained at least D Grades in 50% Courses of Second Semester Examinations shall be allowed to take admission in Third Semester
• **Dropout** : Dropout student will be allowed to register for respective semester as and when the concerned courses are offered by the department, subject to the condition that his/her tenure should not exceed more than twice the duration of course from the date of first registration at parent department.

• **Duration** :
  - **Minimum** : As per structure of the course
  - **Maximum** : twice the minimum duration of course
Credits and Degrees

• **Consideration of Teaching Work Load**: One Credit shall mean one teaching period of one hour per week for one semester (of 15 weeks) for theory courses and two practical / laboratory / field / demonstration hours / week for one semester.

• **Total number of Minimum Credits to Be completed by the students completing course having Practical's etc**: Every student will have to complete at least 100 credits to obtain the masters degree (Post graduate degree) in the subjects having practical's / laboratory / field / demonstration work out of which 96 credits should be from their respective subject and four credits from service courses
  
  - Autonomous departments can design the curriculum of more credits and it will be compulsory for the students from that department to complete the credits accordingly

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University Ordinance O.886 [Credits & Degrees]
Credits and Degrees

• **Total number of Minimum Credits to Be completed by the students completing course without Practical's etc:** Every student will have to complete at least 68 credits to obtain the masters degree (Post graduate degree) in the subjects without practical's / laboratory / field / demonstration work out of which 64 credits should be from their respective subject and four credits from service courses.
  
  - Autonomous departments can design the curriculum of more credits and it will be compulsory for the students from that department to complete the credits accordingly.

• **Conferring Degree:** A candidate who has successfully completed all the Core Courses, Elective/ Specialized Courses, Seminars and Project prescribed and or Optional Service Courses approved by the University for the programme with prescribed CGPA shall be eligible to receive the degree.
A. Core Course: A core course is a course that a student admitted to a particular P.G. programme must successfully complete to receive the degree. Normally no theory course shall have more than 4 credits.

B. Elective Course: Means an optional course from the basic subject or specialization.

C. Service course (SC): The service courses will be offered in third and fourth semesters in different departments of the University. Student should complete at least one service course in any semester.
Each Course shall include lectures / tutorials / laboratory or field work / Seminar / Practical training / Assignments / midterm and term end examinations / paper / Report writing or review of literature and any other innovative practice etc., to meet effective teaching and learning needs.

**Attendance**: Students must have 75% of attendance in each Core and Elective course for appearing the examination. However, a student having 65% attendance with a medical certificate may apply to the H.O.D. for condonation of attendance.
Registration for Service Courses

- **Enrollment**: The student will register the service course of his interest after the start of semester in the concerned department on official registration form.

- **Record Handling for Service Course**: The teacher in-charge of the respective course will keep the record of the students registered. Maximum fifteen days period will be given from the date of admission for completion of registration procedure. The Departmental Committee shall follow a selection procedure after counseling to the students etc. to avoid overcrowding to particular course(s) at the expense of some other courses.
Registration for Service Courses

- **Minimum Courses Options:** No student shall be permitted to register for more than one service course in a semester and Normally no service course shall be offered unless a minimum of 10 students are registered.

- **Maximum Student Intake For Service Course:** The University shall decide the maximum number of students in each service course taking into account the teachers and Physical facilities available in the Department.

- **Fees:** The student shall have to pay the prescribed fee per course per semester/ year for the registration as decided by the University
Registeration for Service Courses

- **Minimum Courses Options**: No student shall be permitted to register for more than one service course in a semester and Normally no service course shall be offered unless a minimum of 10 students are registered.

- **Maximum Student Intake For Service Course**: The University shall decide the maximum number of students in each service course taking into account the teachers and Physical facilities available in the Department.

- **Fees**: The student shall have to pay the prescribed fee per course per semester/year for the registration as decided by the University.
• **Notification of Service course:** The University may make available to all students a listing of all the courses offered in every semester specifying the credits, the prerequisites, a brief description or list of topics the course intends to cover, the instructor who is giving the courses, the time and place of the classes for the course. This information shall be made available on the University website.
Every P.G. programme of the University / College shall be monitored by a committee constituted for this purpose by the Department.

The Committee shall consist of H.O.D. as a Chairman and some/all the teachers of the Department as its members.
Case Study

The Case Study Recipe

Problem  Solution  Results

Department of Computer Science and IT

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CBCS Pattern

- M.Sc. (Computer Science)
- M.Sc. (Information Technology)
- M.Phil. (Computer Science)
- M.Tech (Computer Science and Engineering)
Classified various courses in terms of their credits

Example:
Course title: Adv. Java
Course code: CSC 401, CSI 401
           CSC 451, CSI 451

C – Computer Science
I – Information Technology

4 – Number of Credits
0 – T  5 – P
The Course

• In each semester credit limit should not be exceeded 24, Four semesters = 104 Credits

• In every semester the courses offered by the Department will be known to students.

• Students can opt for the listed courses

• One or more than one teacher will be assigned to each course
The Course: Syllabus

- Teachers must provide details
  - Describe the objective
  - Describe detail time table with calendar
  - Text books, Reference books will be mentioned
  - Method of evaluation
Teachers Responsibility

- Teacher’s information
  - Contact number & availability to students
- Course description
  - Objective & topic to be covered
- Text books, Ref. books and other references
  - Describe all materials to be used in the course
- Exams & Grading
  - How students will graded
- Programming Assistance
  - Weightage grading and Assignments
- Scheduled for Topics & lectures
  - Details time schedule for lectures

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At the end of each semester, students will be graded and will be handed over to the HOD and will be approved by the departmental committee.

Department will submit these grades to the University for official results to Students.
## Ten point grades and grade description

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Equivalent percentage</th>
<th>Grade points</th>
<th>Grade</th>
<th>Grade description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90.00-100</td>
<td>9.00-10</td>
<td>O</td>
<td>Outstanding</td>
</tr>
<tr>
<td>2</td>
<td>80.00-89.99</td>
<td>8.00-8.99</td>
<td>A++</td>
<td>Excellent</td>
</tr>
<tr>
<td>3</td>
<td>70.00-79.99</td>
<td>7.00-7.99</td>
<td>A+</td>
<td>Exceptional</td>
</tr>
<tr>
<td>4</td>
<td>60.00-69.99</td>
<td>6.00-6.99</td>
<td>A</td>
<td>Very good</td>
</tr>
<tr>
<td>5</td>
<td>55.00-59.99</td>
<td>5.50-5.99</td>
<td>B+</td>
<td>Good</td>
</tr>
<tr>
<td>6</td>
<td>50.00-54.99</td>
<td>5.00-5.49</td>
<td>B</td>
<td>Fair</td>
</tr>
<tr>
<td>7</td>
<td>45.00-49.99</td>
<td>4.50-4.99</td>
<td>C+</td>
<td>Average</td>
</tr>
<tr>
<td>8</td>
<td>40.01-44.99</td>
<td>4.01-4.49</td>
<td>C</td>
<td>Below average</td>
</tr>
<tr>
<td>9</td>
<td>40</td>
<td>4.00</td>
<td>D</td>
<td>Pass</td>
</tr>
<tr>
<td>10</td>
<td>&lt;40</td>
<td>0.00</td>
<td>F</td>
<td>Fail</td>
</tr>
</tbody>
</table>
How to calculate final CGPA

• First Semester Grade Point Average (SGPA) is calculated for each semester.

\[
SGPA = \frac{\text{Sum}(\text{Course Credit} \times \text{Number of Points in Concern Course gained by the student})}{\text{Sum}(\text{Course Credits})}
\]

• The Cumulative Grade point Average (CGPA) will be used to describe the overall performance of a student in all semesters of the course and will be computed as under:

\[
CGPA = \frac{\text{Sum}(\text{All semesters SGPA})}{\text{Sum}(\text{Credits of all Semesters})}
\]
### Course: M.Sc [Information Technology] Sem-I
### Month/Year of Examination: NOV/DEC 2011

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Seat No</th>
<th>Name of the Candidate</th>
<th>Course 1</th>
<th>Course 2</th>
<th>Course 3</th>
<th>Course 4</th>
<th>Credit</th>
<th>Grade</th>
<th>Previous</th>
<th>CCCODE</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>1</td>
<td>CSC1001</td>
<td>Student A</td>
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<tr>
<td>2</td>
<td>CSC1002</td>
<td>Student B</td>
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<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Highest Grade

<table>
<thead>
<tr>
<th>Course 1</th>
<th>Course 2</th>
<th>Course 3</th>
<th>Course 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

#### Lowest Grade

<table>
<thead>
<tr>
<th>Course 1</th>
<th>Course 2</th>
<th>Course 3</th>
<th>Course 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>Semester</td>
<td>Course Title</td>
<td></td>
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<tr>
<td>----------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sem-I</td>
<td>Advanced Java</td>
<td></td>
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<tr>
<td></td>
<td>Data Structure and Analysis of Algorithm</td>
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<td></td>
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<tr>
<td></td>
<td>Neural Network</td>
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<tr>
<td></td>
<td>Advanced Neural Network and Fuzzy System</td>
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<tr>
<td></td>
<td>Digital Signal Processing</td>
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<td></td>
<td>Image Processing</td>
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<td></td>
<td>Advanced Operating System</td>
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<tr>
<td></td>
<td>Parallel Computing</td>
<td></td>
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<tr>
<td>Sem-II</td>
<td>Java Network Programming</td>
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<tr>
<td></td>
<td>Advanced Software Engineering and Technology</td>
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<tr>
<td></td>
<td>Computer Vision</td>
<td></td>
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<tr>
<td></td>
<td>Elective - I: (Select any one from list of elective I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Advanced Embedded System</td>
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<td></td>
<td>2. Data Ware Housing</td>
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<td></td>
<td>3. GIT</td>
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<td></td>
<td>4. Biometric Techniques</td>
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<td>5. Mobile Computing</td>
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<td>Sem-III</td>
<td>Pattern Recognition</td>
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<td>Elective - II: (Select any one from list of elective II)</td>
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<td></td>
<td>1. Theoretical Computer Science</td>
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<td>2. Decision Support System &amp; Intelligent System</td>
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<td>3. Data Mining</td>
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<td>4. Cryptography and Network Security</td>
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<td>5. Introduction to MEMS Pro+</td>
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### Semester-I

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<tr>
<th>Course Code</th>
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<th>No. of Credits</th>
<th>No. of Hours / Week</th>
<th>Total Marks:100</th>
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<th>Internal</th>
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<td>Advanced Java</td>
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<td>CSC402</td>
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<td>Practical Based on CSC401</td>
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<td>4 (Per Batch)</td>
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<td><strong>Total No of Credits in Sem-I</strong></td>
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### Semester-II

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<td>CSC406</td>
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<td>CSC407</td>
<td>Image Processing</td>
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<td>CSC408</td>
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Course Objective
This course assumes that students are aware of core Java programming and hence it starts from threading and goes up to web programming. It covers some advance topics of reflection, applets, swings, JDBC, Networking, JSP and Servlet.

At Course Completion
After completion of this course students can write good application based on java. Students can appear for Java certification examinations. Student can also work on networking and web projects.

Prerequisites
Student should know the programming in core Java.

UNIT I:

UNIT II:
Java Database Connectivity: JDBC, JDBC Architecture (type 1, type 2, Type 3, type 4) the java.sql.* package, Connection, ResultSet, Statements
UNIT III:

UNIT IV:

UNIT V:

Books
1. Java 2 Complete Reference by Herbert Schildt (Sixth Edition)
2. Core Java Vol 1: Sun Press
3. Core Java Vol 2: Sun Press

Additional Web Reference
http://www.javapassion.com/javaintro/
Presentation Slides (Available in .ppt format)

E-book:
1. Java 2 Complete Reference by Herbert Schildt (Fourth Edition)

Lab Exercise: CSC451 Practical based on CSC401
At least two experiments should be carried out on each unit.
Dr. Babasaheb Ambedkar Marathwada University,
Department of Computer Science and Information Technology,
End Term Semester Examination: 21-04-2012
M. Sc. II (Computer Science): Neural Networks and Fuzzy Logic (CSC406)

Time: 3 Hour (11:00 am to 2:00 pm) Max Marks: 80

NB: Part A is compulsory. Attempts any five from Part B.

SECTION-A

1. [A] Fill in the blanks by an appropriate choice. (2X5 marks)
   i. A vector of a state is called a ............... vector.
      a) state    c) straight
      b) linear   d) current state
   ii. If the trajectories shoot off to infinity then the system is said to be ............
      a) unstable  c) Non-stationary
      b) stable    d) Orbital
   iii. OLAM stands for
      a) Orthogonal Linear Attractive Memory
      b) Orthogonal Linear Attractive Models
      c) Orthogonal Linear Associative Memory
      d) Orthonormal Linear Associative Memory
   iv. In self-organizing process, the cluster unit whose weight vector matches the input pattern closely selected as ............
      a) Runner
      b) Neighborhood
      c) Competitive
      d) winner
   v. ................. is the process of grouping together data points based on some measures of distance.
      a) Clustering
      b) Non-clustering
      c) Mapping
      d) Learning

[B] Match the Following. (2X5 marks)

<table>
<thead>
<tr>
<th>Net Algorithm</th>
<th>Stopping Criteria</th>
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</thead>
<tbody>
<tr>
<td>i. LVQ</td>
<td>A) fixed number of iterations or learning rate reaching a sufficiently small value</td>
</tr>
<tr>
<td>ii. Maxnet</td>
<td>B) if more than one node has nonzero activation, continue, otherwise stop</td>
</tr>
<tr>
<td>iii. ART1</td>
<td>C) no weights changes, no units reset or max. no. of epochs searched</td>
</tr>
<tr>
<td>iv. Mexican Hat</td>
<td>E) if t &lt; t-max, continue, otherwise, stop.</td>
</tr>
<tr>
<td>v. Hamming Net</td>
<td>F) Best match exemplar.</td>
</tr>
</tbody>
</table>

30-Sep-15    Professor K. V. Kale, Director, B. C. U. D., Dr. B. A. M. University
SECTION-B

2. Consider a BAM network (with bipolar vectors) to map two simple letters (given by 5x3 patterns) to the following bipolar target codes:

\[
\begin{array}{c}
* & * & * \\
* & * & * \\
* & * & * \\
* & * & * \\
* & * & * \\
\text{Pattern (E) (-1, 1)} \\
\end{array}
\quad \quad \quad \quad \quad \\
\begin{array}{c}
* & * & * \\
* & * & * \\
* & * & * \\
* & * & * \\
* & * & * \\
\text{Pattern (H) (1, 1)} \\
\end{array}
\]

(a) Find the weight matrix with input pattern E and H.
(b) Obtain the response of the net with E as input. \hspace{2cm} (6 marks)
(6 marks)

3. A Kohonen self organizing map is shown with weights in the following figure.

(a) Using the square of the Euclidean distance find the cluster unit \( c_j \) that is closest to the input vector \( (0.3, 0.4) \)
(b) Using a learning rate of 0.3, find the new weights for unit \( c_j \).

4. Give the architecture of ART1 and ART2 and discuss the similarity and differences between them. \hspace{2cm} (12 marks)

5. What are the various classification of competition based nets? How is competition performed for supervised learning and unsupervised learning? \hspace{2cm} (12 marks)

6. Illustrate the concept of attractor and stability in dynamic network systems with fixed point attractor example \hspace{2cm} (12 marks)

7. (a) Explain training algorithms of Learning Vector Quantization (LVQ) net.
(b) Explain the discrete Hopfield network with its architecture. \hspace{2cm} (6 marks)
(6 marks)

8. Write short note on (any two)
   a. Genetic Algorithm (GA)
   b. Fuzzy sets and its Membership Functions
   c. Support Vector Machine (SVM)
   d. Application of Neural Networks

(6x2 marks)
Thank You