College Calendar 2021-22

Department of
Computer Science & Engineering

Syllabus
of
3rd Year
Do you know in how many ways the ‘Knowledge’ serves his master? Like mother it protects, like father it teaches and guides, like wife, provides all kinds of happiness after destroying all sorrows, it brings wealth from every corner and spreads the fame in all direction. Like ‘Kalpalatha’ knowledge offers everything to human being whatever he wishes.

(An Autonomous Institution affiliated to VTU, Belagavi)
NITTE-574110, Karkala Taluk, Udupi District, Karnataka, India
ISO 9001:2015 Certified, Accredited by NAAC with “A” Grade

COLLEGE CALENDAR
2021-22
(V & VI Semester)
Vision Statement

Pursuing Excellence, Empowering people, Partnering in Community Development

Mission Statement

To develop N.M.A.M. Institute of Technology, Nitte, as Centre of Excellence by imparting Quality Education to generate competent, Skilled and Humane Manpower to face emerging Scientific, Technological, Managerial and Social Challenges with Credibility, Integrity, Ethics and Social Concern.
In Memorium

Late Nitte Mahalinga Adyanthaya
Our Founder

Late Justice K. S. Hegde
1909-1990
SRI N. VINAYA HEGDE
President, Nitte Education Trust
Chancellor, Nitte (Deemed to be University), Mangaluru
<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of the Faculty</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dr. Niranjan N. Chiplunkar</td>
<td>Principal</td>
</tr>
<tr>
<td>2.</td>
<td>Mr. Yogeesh Hegde</td>
<td>Registrar</td>
</tr>
<tr>
<td>3.</td>
<td>Dr. Shrinivasa Rao B. R.</td>
<td>Vice Principal / Controller of Examinations / Professor</td>
</tr>
<tr>
<td>4.</td>
<td>Dr. I. Ramesh Mithanthaya</td>
<td>Vice Principal / Dean (Academics) / Professor</td>
</tr>
<tr>
<td>5.</td>
<td>Dr. Sudesh Bekal</td>
<td>Dean (R&amp;D)/Professor</td>
</tr>
<tr>
<td>6.</td>
<td>Dr. Rajesh Shetty K.</td>
<td>Dean (Admissions) / Professor</td>
</tr>
<tr>
<td>7.</td>
<td>Dr. Subrahmanya Bhat K.</td>
<td>Dean (Student Welfare) / Professor</td>
</tr>
<tr>
<td>8.</td>
<td>Dr. Nagesh Prabhu</td>
<td>PG Coordinator/Professor</td>
</tr>
<tr>
<td>9.</td>
<td>Dr. Srinath Shetty K.</td>
<td>Resident Engineer/Professor</td>
</tr>
</tbody>
</table>

**HEADS OF DEPARTMENTS**

1. Prof. Shalini K. Sharma                          Counseling, Welfare, Training & Placement  
2. Dr. Arun Kumar Bhat                              Civil Engg.  
3. Dr. Jyothi Shetty                                Computer Science & Engg.  
5. Dr. Srinivas Pai P.                              Mechanical Engg.  
6. Dr. KV SSSS Sairam                               Electronics & Communication Engg.  
7. Dr. Suryanarayana K.                             Electrical & Electronics Engg.  
8. Dr. Ujwal P.                                     Biotechnology Engg.  
10. Dr. Sharada Uday Shenoy                         Artificial Intelligence & Machine Learning Engg.  
12. Dr. Kumudakshi                                  Mathematics  
13. Dr. Shobha R. Prabhu                            Physics  
14. Dr. Shivaprasad Shetty M.                       Chemistry  
15. Mrs. Rashmi D. Hegde                            Humanities  
16. Dr. Surendra Shetty                             MCA  

**INCHARGE OF INSTITUTION’S RESPONSIBILITIES**

1. Dr. Gururaj Upadhyaya                             Workshop Supdt.  
2. Dr. Narasimha Bailkeri                            1st year Coordinator  
3. Dr. Venkatesh Kamath                              Deputy Controller of Examination  
4. Dr. Janardhan Nayak                               Co-ordinator, Red Cross Unit
5. Mr. Srinivas Nekkar  
6. Mr. Krishnaraja Joisa  
7. Dr. Jnaneswar Pai Maroor  
8. Sri. Shekar Poojari  
9. Dr. Shivaprasad Shetty M.  

**ENTREPRENEURSHIP DEVELOPMENT CELL**

1. Dr. Ramakrishna B.  
2. Mrs. Geetha Poojarthi  

**DEPARTMENT OF TRAINING & PLACEMENT**

1. Mr. Bharath G. Kumar  

**DEPARTMENT OF MATHEMATICS**

1. Dr. Shashirekha B. Rai  
2. Dr. P. Shankaran  
3. Dr. Kumudakshi  
4. Dr. Sharad M. Hegde  
5. Dr. Vasanth K. R.  
6. Mrs. Ambika N.  
7. Mrs. Vinaya Acharya  
8. Mrs. Anitha D. Bayar  
9. Mrs. Bhavya K.  
10. Ms. Chaithra K.  
11. Mrs. Bhavya. D.  
12. Mrs. Sharmila  
13. Mrs. Anjana Pai K.  
14. Mrs. Soumya  
15. Mrs. Smitha G. V.  

**DEPARTMENT OF PHYSICS**

1. Dr. K. B. Vijaya Kumar  
2. Dr. Sathyajith K. T.  
3. Dr. Manjunath K. B.  
4. Dr. Shobha R. Prabhu  
5. Dr. Nagaraja B. S.  
6. Dr. Raghavendra Bairy  
7. Dr. Shyam Prasad K.
DEPARTMENT OF CHEMISTRY
1. Dr. Janardhana Nayak Professor
2. Dr. Ramesh Bhat Asso. Professor
3. Dr. Shivaprasad Shetty M. Asst. Professor Gd III/HoD
4. Dr. Aarti S. Bhat Asst. Professor Gd III
5. Dr. Subrahmanya Ishwar Bhat Asst. Professor Gd III
6. Mr. Sarvajith M. S. Asst. Professor

DEPARTMENT OF HUMANITIES
1. Dr. Ramakrishna B. Professor
2. Mrs. Rashmi D. Hegde Asso. Professor/HoD
3. Dr. Vishwanatha Asso. Professor
4. Dr. Jnaneshwar Pai Maroor Asst. Professor Gd III
5. Dr. Joy Elvine Martis Asst. Professor Gd III
6. Mrs. Shyla D. Mendonca Asst. Professor Gd II
7. Ms. Sonia Lobo Asst. Professor Gd I
8. Mr. Srinivasis Nekkar Asst. Professor
9. Mrs. Sudeeksha S. Pai Asst. Professor

OFFICE SECTION HEADS
1. Mr. Keshava Mugeraya Sr. Supdt., Academic Section/ Purchase In-Charge
2. Mrs. Suneetha R. Shetty Sr. Supdt., Administrative Section
3. Mr. Suresh Achar Sr. Supdt., Stores
4. Mrs. Jayashree Sr. Programmer
5. Mrs. Shailaja V. Shetty Supdt., Accounts Section
6. Sri. Sudhakar K. Incharge Librarian

SECURITY DEPARTMENT
1. Mr. Hirianna Suvarna S. Security Supervisor

SPORTS DEPARTMENT
1. Sri. Shyam Sundar M. P.E.D
2. Sri. Ganesh Poojary P.E.D
3. Ms. Sowjanya M. P.E.I
4. Mr. Ravi Prakash C. Anpur Basket Ball Coach
HOSTEL WARDENS

1. Dr. Veena Devi S.V  
   Chief Warden, NET Ladies Hostels, Nitte
2. Dr. Vishwanatha  
   Chief Warden, NET Gents Hostels, Nitte

HOSTEL SUPERINTENDENT / MANAGER

1. Mr. John D’Souza  
   Sr. Manager, Gents Main Hostel
2. Mr. Francis D’Souza  
   Hostel Manager, Gents Main Hostel
3. Mr. Rajesh Ballal  
   Supervisor, Gents PG Hostel
4. Mrs. Gayathri Kamath  
   Supdt. Ladies PG Hostel
5. Mrs. Chethana Sharma  
   Supdt. Ladies Main Hostel
6. Mrs. Hema S. Hegde  
   Supdt., Hostel Office
REGULATIONS

2021-22
(Applicable for admission batch 2018-19 onwards)

COMMON TO ALL B.E. (CREDIT SYSTEM)

DEGREE PROGRAMMES
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REGULATIONS

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19. LISTS OF MAJOR SCHOLARSHIPS
REGULATIONS COMMON TO ALL B.E. (CREDIT SYSTEM) DEGREE PROGRAMMES OF
NMAM INSTITUTE OF TECHNOLOGY, NITTE
Karkala, Udupi Dist., Karnataka

1. INTRODUCTION

1.1 The general regulations are common to all B.E. (Credit System) Degree Programmes conducted at the NMAMIT, Nitte Campus and shall be called “NMAMIT Regulations”.

1.2 The provisions contained in this set of regulations govern the policies and procedures on the Registration of students, imparting Instructions of course, conduct of the examination and evaluation and certification of student’s performance and all amendments related to the said Degree programme(s).

1.3 This set of Regulations, on approval by the Academic Council and Governing Council, shall supersede all the corresponding earlier sets of regulations of the BE Degree program (of VTU) along with all the amendments thereto, and shall be binding on all students undergoing the Graduate Degree Programme(s) (Credit System) conducted at the NMAMIT, Nitte with effect from its date of approval. **This set of Regulations, may evolve and get modified or changed through appropriate approvals from the Academic Council / Governing Council from time to time, and shall be binding on all stake holders (The Students, Faculty, Staff of Departments of NMAMIT, Nitte).** The decision of the Academic Council/ Governing Council shall be final and binding.

1.4 In order to guarantee fairness and justice to the parties concerned in view of the periodic evolutionary refinements, any specific issues or matters of concern shall be addressed separately, by the appropriate authorities, as and when found necessary.

1.5 The Academic Council may consider any issues or matters of Concern relating to any or all the academic activities of NMAMIT courses for appropriate action, irrespective of whether a reference is made here in this set of Regulations or otherwise.

1.6 The course shall be called **Bachelor of Engineering** course abbreviated as B.E. (Subject of specialization) – Credit System.

1.7 DURATION OF THE COURSE

(a) The course shall extend over a period of total duration of 4 years.

(b) Each year shall have the following schedule with 5 ½ days a week.

Suggested Break down of Academic Year into Semesters
1. No. of Semesters / Year Three; Two being Main semesters (odd, even) and one being a supplementary semester; after 2 main semesters.
   (Note: Supplementary semester is primarily to assist weak and/ or failed students through make up courses. However, Autonomous Colleges may use this semester to arrange Add-On courses for other students and/ or for deputing them for practical training elsewhere.)

2. Semester Duration
   | Main semester (odd, even) each 19 Weeks; Supplementary Semester 8 Weeks |

3. Academic Activities
   | Main Semester |
   | (Weeks): |
   | Registration of Courses & Course Work (16.0) |
   | Examination Preparation and Examination (3.0) |
   | Total (19) |
   | Supplementary Semester |
   | Registration of Courses & Course Work (5.0) |
   | Examination Preparation and Examination (3.0) |
   | Total (8) |
   | Declaration of results: 2 weeks from the date of last examination |
   | Inter- Semester Recess: |
   | After each Main Semester (2) |
   | Total Vacation: 10 weeks (for those who do not register for supplementary semester) and 4 weeks (for those who register for supplementary semester) |

(Note: In each semester, there will be provision for students for Registration of courses at the beginning, dropping of courses in the middle and withdrawal from courses towards the end, under the advice of faculty member. These facilities are expected to enhance the learning capabilities of students, minimizing their chances of failure in courses registered and also ensure their better monitoring by Faculty Advisors).

A candidate shall be allowed a maximum duration of eight years from the first semester of admission to become eligible for the award of Bachelor Degree.

The calendar of events in respect of the course shall be fixed by the Senate from time to time, but preferably in line with the academic calendar of the VTU.)
2. DEGREE PROGRAMMES
2.1 Undergraduate B.E. Degree Programmes are offered in the following disciplines by the respective programme hosting departments listed below:

i) Biotechnology Engineering (BT)
ii) Civil Engineering (CV)
iii) Computer Science & Engineering (CS)
iv) Electronics & Communications Engineering (EC)
v) Electrical & Electronics Engineering (EE)
vi) Information Science & Engineering (IS)
vii) Mechanical Engineering (ME)
viii) Artificial Intelligence and Machine Learning Engg. (AM)*
ix) Computer and communication Engineering (CC)*
x) Robotics and Artificial Intelligence Engineering (RA)*

Other teaching departments are –

i) Mathematics (MA)
ii) Physics (PH)
iii) Chemistry (CY)
iv) Humanities, Social Sciences and Management (HU)

2.2 The provisions of these Regulations shall be applicable to any new discipline* that may be introduced from time to time and appended to the above list.

3. REGISTRATION
3.1 Every student after consulting his Faculty Advisor in parent department shall register approved courses (core and elective) to earn credits for meeting the requirements of degree program at the commencement of each Semester on the days fixed for such registration and notified in the academic calendar. Students who fail to register on or before the specified date will have to pay a late fee. Such courses together with their grade and credits earned will be included in the grade card issued by the college at the end of each semester, like odd, even, supplementary and it forms the basis for determining the student’s performance in that semester.

3.2 Lower and Upper Limits for Course Credits Registered in a Semester

Course Credit Assignment

All courses comprise of specific Lecture/Tutorial/Practical (L-T-P) schedule. The course credits are fixed based on the following norms.

Lecture / Tutorials / Practical:

i) One hour Lecture per week is assigned one Credit.
ii) 2-hour Tutorial session per week is assigned 1.0 Credit.
iii) 2-hour Lab. session per week is assigned 1.0 credit.
For example, a theory course with L-T-P schedule of 3-2-0 hours will be assigned 4.0 credits.

A laboratory practical course with L-T-P schedule of 0-0-2 hours will be assigned 1.0 credit.

Calculation of Contact Hours / Week – A Typical Example

<table>
<thead>
<tr>
<th>No. of Courses</th>
<th>Credits / Course</th>
<th>Total Credits</th>
<th>Contact Hours per Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Lecture Courses</td>
<td>3:0:0</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2 Lec. cum Lab Courses</td>
<td>3:0:1</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>2 Lec. cum Tut. Courses</td>
<td>3:1:0</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>1 Lec. Tut. cum Lab Courses</td>
<td>1:1:1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10:2:2</strong></td>
<td><strong>25</strong></td>
<td><strong>31</strong></td>
</tr>
</tbody>
</table>

A student must register, as advised by Faculty Advisor, between a minimum of 16 credits and up to a Maximum of 28 credits.

3.3 **Mandatory Pre-Registration for higher semester**

In order to facilitate proper planning of the academic activities of the Semester, it is necessary for the students to declare their intention to register for courses of higher semesters (3rd and above) at least two weeks before the end of the current semester choosing the courses offered by each department in the next higher semester which is displayed on the Department Notice Board at least 4 weeks prior to the last working day of the semester.

Registration to a higher semester is allowed only if the student fulfills the following conditions -

i) satisfied all the academic requirements to continue with the programme of studies without termination

ii) cleared all Institute, hostel and library dues and fines, if any, of the previous semester

iii) paid all required advance payments of the Institute and the hostel for the current semester

iv) has not been debarred from registering on any specific grounds by the Institute.
4. **ADD / DROP / AUDIT options**

4.1 **Registration of courses**

Each student shall have to register for course work at the beginning of a semester within 2 to 3 days of commencement after discussing with subject teacher and under faculty advice. The permissible course load to be either average credits (=22) or to be within the limits of minimum (=16) and maximum (=28) credits.

4.2 **DROP-option**

During a specified period at the middle of a semester student’s performance in CIE is reviewed by the faculty advisor. Following poor performance by a student he/she can be facilitated to drop identified course(s) (up to the minimum credits specified for the semester). Such course(s) will not be mentioned in the Grade card. Such courses to be re-registered by these students and taken up for study at a later time.

4.3 **Withdrawal from courses**

During a specific period specified towards the end of the semester, student’s performance in CIE is reviewed by the Faculty advisors. Following poor performance by a student in identified course(s) he/she is advised to withdraw from such course(s) (up to the minimum credits specified for the semester) with mention in the Grade card (Grade ‘W’). Such courses to be re-registered by these students and taken up for study at a later time.

4.4 **AUDIT-option**

A student can register for courses for audit only, with a view to supplement his/her knowledge and/or skills. The student’s grades in such course(s) will have to be reflected in the grade card. However, CORE courses shall not be made available for audit. But these shall not be taken into account in determining the student’s academic performance in the semester. ‘U” grade is awarded to such courses on satisfying the attendance requirements and CIE requirements. The candidate need not appear for SEE in such courses.

5. **COURSE STRUCTURE:**

5.1 Typical Breakdown for the B.E. Degree Curriculum:

<table>
<thead>
<tr>
<th>No.</th>
<th>Course Category</th>
<th>Credit Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Basic Sciences (BSC)</td>
<td>24-30</td>
</tr>
<tr>
<td>2.</td>
<td>Engineering Sciences (ESC)</td>
<td>15 -20</td>
</tr>
<tr>
<td>3.</td>
<td>Humanities, Social Sciences and Management</td>
<td>7-10</td>
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<td>---</td>
<td>-------------------------------------------------</td>
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</tr>
<tr>
<td>4.</td>
<td>Professional Courses (PCC) – core</td>
<td>70 - 90</td>
</tr>
<tr>
<td>5.</td>
<td>Professional Courses (PEC) – elective</td>
<td>18</td>
</tr>
<tr>
<td>6.</td>
<td>Open Elective Courses (OE)</td>
<td>06</td>
</tr>
<tr>
<td>7.</td>
<td>Project Work (PROJ)</td>
<td>16 (VI – 2, VII-2, VIII-12)</td>
</tr>
<tr>
<td></td>
<td>Seminar on Current Topic</td>
<td>01</td>
</tr>
<tr>
<td>8.</td>
<td>Internship</td>
<td>03</td>
</tr>
<tr>
<td>9.</td>
<td>Mandatory Learning courses</td>
<td>Non-Credit</td>
</tr>
</tbody>
</table>

**Note:** Student can register between 16 to 28 credits per semester

Total Credits to be earned : 175

5.2 The Department Undergraduate Committee (DUGC) will discuss and recommend the exact credits offered for the programme for the above components ‘a’ to ‘g’, the semester wise distribution among them, as well as the syllabi of all undergraduate courses offered by the department from time to time before sending the same to the Board of Studies (BOS). The BOS will consider the proposals from the departments and make recommendations to the senate for consideration and approval.

5.3 **The earned Credit Requirement for the B.E. Degree is 175.**

Degree is awarded by prescribing the total number of credits to be earned, rather than by using the program duration, giving flexibility to student to plan their career.

5.4 **Mandatory Learning Courses**

These are courses that must be completed by the student at appropriate time or at his convenience. The ‘PP’ grade is awarded for a Pass in the course and ‘NP’ grade is awarded for a Fail in the course. In case ‘NP’ grade is awarded, the student has to re-register for the same course wherein he has no alternative options. However, he/she can opt for other courses if he/she has been provided with multiple options.

The ‘PP’ and ‘NP’ grades do not carry grade points and hence not included in the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) computations. However such non-credit mandatory courses are required to be included in the students’ performance record (transcript) with Pass or Fail (PP or NP).

Courses that come under this category are the following.

Moral and Ethical Values, Communication skills, Entrepreneurship Development Programme, Environmental issues, Constitution of India, Proficiency in a Language etc.
Such courses will not carry any credits for the award of degree, but a pass in each of such course during the programme shall be a necessary requirement for the student to qualify for degree award.

5.5 PROJECT

i) Project work at 8th semester shall be completed batch wise. The batch shall consist of a maximum of 4 students.

ii) Project viva-voce examination shall be conducted individually.

5.6 ELECTIVES

i) A candidate shall take electives in each semester from groups of electives, commencing from 5th semester.

ii) The minimum number of students to be registered for any Elective offered shall not be less than ten.

iii) A candidate shall opt for his/her choice of electives and register for the same if pre-registration is not done, at the beginning of each of 5th, 6th, 7th and 8th semesters. The candidate is permitted to opt for change of elective within 15 days from the date of commencement of the semester as per the academic calendar of the college.

6. ATTENDANCE REQUIREMENT:

6.1 Each semester is considered as a unit and the candidate has to put in a minimum attendance of 85% in each subject with a provision of condoning 10% of the attendance by Principal for reasons such as medical grounds, participation in University level sports, cultural activities, seminars, workshops and paper presentation.

6.2 The basis for the calculation of the attendance shall be the period of term prescribed by the College by its calendar of events. For the first semester students, the same is reckoned from the date of admission to the course (as per CET/COMED-K or Management allotment).

6.3 The students shall be informed about their attendance position in the first week of every month by the College so that the students shall be cautioned to make up the shortage.

6.4 A candidate having shortage of attendance (<75%) in any course(s) registered shall not be allowed to appear for SEE of such course(s). Such students will be awarded ‘N’ grade in these courses.

He/she shall have to repeat those course(s). Such students shall re-register for the same course(s) core or elective, as the case may be when the particular course is offered next either in a main (odd/even) or supplementary semester.

6.5 Attendance in CIE and SEE: Attendance at all examinations both CIE and SEE of each course registered shall be compulsory and there shall not be any provision for re-examinations. Any student against whom any disciplinary action is pending shall not be permitted to attend any SEE in that semester.
7. **WITHDRAWAL FROM THE PROGRAMME**

7.1 **Temporary Withdrawal**

(a) A student who has been admitted to a degree programme of the college may be permitted once during the course to withdraw temporarily, for a period of one semester, on the grounds of prolonged illness or grave calamity in the family etc., provided –

(i) The student applies to the College within 6 weeks of the commencement of the college stating fully the reasons for withdrawal together with supporting documents and endorsement from his parent/guardian.

(ii) The College is satisfied about the genuineness of the case and that even by taking into account the expected period of withdrawal, the student has the possibility to complete the programme requirements (175 credits) within the time limits specified by the university.

(iii) The student does not have any dues or demands at the College / University including tuition and other fees as well as library material.

(iv) A student availing of temporary withdrawal shall be required to pay such fees and/or charges as may be fixed by the college until such time as his/her name appears on the Student’s roll list. The fees/charges once paid shall not be refunded.

(v) A student will be entitled to avail the temporary withdrawal facility only once during his/her studentship. However, any other concession for the concerned student shall have to be approved by the academic council.

7.2 **Permanent Withdrawal**

Any student who withdraws admission before the closing date of admission for the Academic Session is eligible for the refund of the deposits only. Fees once paid will not be refunded on any account.

Once the admission for the year is closed, the following conditions govern withdrawal of admissions.

(a) A student who wants to leave the College for good, will be permitted to do so (and take Transfer Certificate from the College, if needed), only after remitting the Tuition fees as applicable for all the remaining semesters and clearing all other dues if any.

(b) Those students who have received any scholarship, stipend or other forms of assistance from the College shall repay all such amounts.

(c) The decision of the Principal of the College regarding withdrawal of a student is final and binding.

8. **EVALUATION SYSTEM**

8.1 The Academic Performance Evaluation of a student shall be according to a Letter Grading System, based on the Class Performance Distribution.
8.2 The Letter grades S, A, B, C, D, E, F indicate the level of academic achievement, assessed on a decimal (0-10) scale.

8.3 The Letter grade awarded to a student in a course, for which he has registered shall be based on his performance in quizzes, tutorials, assignments etc., as applicable, in addition to two mid-semester examinations and one semester end examination. The distribution of weightage among these components may be as follows.

- Semester End Examination (SEE) : 50% (50 marks)
- Continuous Internal Evaluation (CIE) : 50% (50 marks)
  i) Quizzes, Tutorials, Assignments, Seminars, mini projects, tutorials etc. : 10 marks
  ii) Mid-semester Examination : 40 marks

Any variation, other than the above distribution, requires the approval of the pertinent DUGC and Academic Council.

8.4 The letter grade awarded to a student in a 0-0-P (Practical) course, is based on an appropriate continuous evaluation scheme that the course instructor shall evolve, with the approval of the pertinent DUGC and the performance in SEE held on specified period in a semester.

8.5 The course Instructor shall announce in the class and/or display at the Faculty door/website the details of the Evaluation Scheme, including the distribution of the weightage for each of the components and method of conversion from the raw scores to the letter-grades within the first week of the semester in which the course is offered, so that there are no ambiguities in communicating the same to all the students concerned.

8.6 **Passing standards**

<table>
<thead>
<tr>
<th>Evaluation Method</th>
<th>Passing Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sessional (CIE)</td>
<td>Score: ≥40% (≥20 marks)</td>
</tr>
<tr>
<td>Terminal (SEE)</td>
<td>Score: ≥40% (≥20 marks)</td>
</tr>
</tbody>
</table>

i) Project work evaluation: The evaluation of CIE of the project work shall be based on the progress of the student in the work assigned by the project supervisor, periodically evaluated by him/her together with a Department committee constituted for this purpose. Seminar presentation, project report and final oral examination conducted by project evaluation committee at the department level shall form the SEE of the project work.

ii) In the case of other requirements, such as, seminar, industrial internship, field work, comprehensive viva voce, if any, the assessment shall be made as laid down by the Academic council.

iii) **There shall be no re-examination for any course in the credit system.**
However, students
- who have abstained from attending CIE or SEE without valid reasons ('N' grade), or
- who have failed ('F' grade) to meet the minimum passing standards prescribed for CIE and/or SEE, or
- who have been detained for want of attendance, or
- who have withdrawn ('W' grade),
- who have dropped any course

shall be required to re-register for such course(s) and go through CIE and SEE again and obtain a grade equal to or better than E in each case. While such students should re-register for same course(s) if core, they can re-register for alternative course(s) from among the elective courses, as the case may be. The re-registration shall be possible when the particular course is offered again either in a main (Odd/Even) or a supplementary semester.

8.7  i) Grade point scale for absolute grading

<table>
<thead>
<tr>
<th>Level</th>
<th>Out</th>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Average</th>
<th>Poor</th>
<th>Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Points</td>
<td>10</td>
<td>09</td>
<td>08</td>
<td>07</td>
<td>06</td>
<td>04</td>
<td>00</td>
</tr>
<tr>
<td>Score (Marks)</td>
<td>≥ 90</td>
<td>&lt; 90- ≥80</td>
<td>&lt; 80- ≥70</td>
<td>&lt; 70- ≥60</td>
<td>&lt; 60- ≥50</td>
<td>&lt; 50- ≥40</td>
<td>&lt; 40</td>
</tr>
<tr>
<td>Range(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ii) The grade points given above help in the evaluation of credit points earned by the student in a course as the credit points are equal to the number of credits assigned to the course multiplied by the grade points awarded to the student in that course. This shall be used in arriving at the credit index of the student for that semester, as it is the sum total of all the credit points earned by the student for all the courses registered in that semester.

8.8  Earning of Credits

A student shall be considered to have completed a course successfully and earned the credits if he/she secures an acceptable letter grade in the range S-E. Letter grade ‘F’ in any course implies failure of the student in that course and no credits earned.
8.9 The Transitional Grades ‘I’, ‘W’ and ‘X’ would be awarded by the teachers in the following cases. These would be converted into one or the other of the letter grades (S-F) after the student completes the course requirements.

- **Grade ‘I’**: To a student having satisfactory attendance at classes and meeting the passing standard at CIE, but remained absent from SEE for valid & convincing reasons acceptable to the College, like:
  
  i) Illness or accident, which disabled him/her from attending SEE;
  
  ii) A calamity in the family at the time of SEE, which required the student to be away from the College;

- **Students who remain absent for Semester End Examinations due to valid reasons and those who are absent due to health reasons are required to submit the necessary documents along with their request to the Controller of Examinations to write Make up Examinations within 2 working days of that particular examination for which he or she is absent, failing which they will not be given permission. This is admissible only for students who have more than 45 CIE marks.**

- **Grade ‘W’**: To a student having satisfactory attendance at classes, but withdrawing from that course before the prescribed date in a semester under Faculty Advice

- **Grade ‘X’**: To a student having attendance \( \geq 85\% \) and CIE rating (90%), in a course but SEE performance observed to be poor, which could result in a F grade in the course. (No ‘F’ grade awarded in this case but student’s performance record maintained separately).

2. **Grade Card**: Each student shall be issued a Grade Card (or Transcript) at the end of each semester. This will have a list of all the courses registered by a student in the semester, together with their credits, the letter grades with grade points awarded. Only those courses registered for credit and having grade points shall be included in the computation of the students performance like SGPA and CGPA and the courses taken for audit will not form part of this computation. The results of mandatory courses, which are of the non-credit type shall also be reflected in the Grade card as PP (for Passed) or NP (for not passed). Each UG student shall have to obtain the grade PP in each mandatory course to qualify for the Degree awarded by the university.

3. **The Make Up Examination**

The Make Up Examination facility would be available to students who may have missed to attend the SEE of one or more course(s) in a semester for valid reasons and given the ‘I’ grade; Also, students having the ‘X’ grade shall be eligible to take advantage of this facility. The makeup examination would be held as per dates notified in the Academic Calendar. However, it would be possible to hold a makeup examination at any other time in the semester with the permission of the Academic Council of the College. In all these cases, the standard of makeup examinations shall be same as the regular SEE for the course(s).
a) In the event of a student in the final semester failing in a Laboratory course and/or in CIE of a course, he/she could be given ‘I’ grade for the course. In such a case the concerned course instructor would have the possibility to grant the student extra time not exceeding 12 weeks for completing the course, with the concurrence of the Department/College. If no such extra time is sought/granted, the concerned student would have to re-register for the course in a succeeding semester and take steps to fulfill the requirements of the Degree.

b) All the ‘I’ and ‘X’ grades awarded to the students would be converted to appropriate letter grades after the make-up examinations. Any outstanding ‘I’ and ‘X’ grades after the last scheduled make-up examinations shall be automatically converted to ‘F’ grade.

c) All the ‘W’ grades awarded to the students would be eligible for conversion to the appropriate letter grades only after the concerned students re-register for these courses in a main/ supplementary semester and fulfill the passing standards for their CIE and (CIE+SEE).

9. EVALUATION OF PERFORMANCE

The overall performance of a student will be indicated by two indices: SGPA; which is the Semester Grade Point Average, and CGPA which is the Cumulative Grade Point Average.

SGPA for a semester is computed as follows.

\[ \text{SGPA} = \frac{\sum [ (course \ credit) \times (Grade \ point)] \ (for \ all \ courses \ in \ that \ semester)}{\sum [ (course \ credits)]} \]

CGPA is computed as follows:

\[ \text{CGPA} = \frac{\sum [ (course \ credits) \times (Grade \ points)] \ (for \ all \ courses \ excluding \ those \ with \ F \ grades \ until \ that \ semester)}{\sum [ (course \ credits)] \ (for \ all \ courses \ excluding \ those \ with \ F \ grades \ until \ that \ semester)} \]

10. COMMUNICATION OF GRADES

The SGPA and CGPA respectively, facilitate the declaration of academic performance of a student at the end of a semester and at the end of successive semesters. Both of them would be normally calculated to the second decimal position, so that the CGPA, in particular, can be made use of in rank ordering the students' performance at a College. If two students get the same CGPA, the tie could be resolved by considering the number of times a student has obtained
higher SGPA; But, if it is still not resolved, the number of times a student has obtained higher grades like S,A,B etc. could be taken into account.

11. VERTICAL PROGRESSION (PROMOTION / ELIGIBILITY TO HIGHER SEMESTERS)

11.1 There shall be no restriction for promotion from an odd semester to the next even semester, provided the student has fulfilled the attendance requirement.

11.2 A Student shall be declared fail if he / she

(i) Has not satisfied the CIE requirements of any Course/s.
(ii) Has not registered for the SEE even after satisfying the attendance and CIE requirements.

11.3 (A) Vertical Progression in case of students admitted to First year:

(a) Students having not more than four F grades in the two semesters of first year of the Programme shall be eligible to move to second year.

(a.1) Students having not more than four F grades in the four semesters of I and II year shall be eligible to move to III year.

(a.2) Students who have earned all the prescribed credits of I year, and having not more than four F grades in the four semesters of II and III year shall be eligible to move to IV year.

(B) Vertical Progression in case of Diploma students admitted to Second year (lateral entry):

(a) Students having not more than four F grades (excluding the Fail or pass status of Additional Mathematics I and II) in the two semesters of II year of the Programme shall be eligible to move to III Year.

(a.1) Students having not more than four F grades (excluding the Fail or pass status of Additional Mathematics I and II, if any) in the four semesters of II and III year shall be eligible to move to IV year.

(b) The mandatory non-credit Courses Additional Mathematics I and II prescribed at III and IV semesters respectively, to lateral entry Diploma holders admitted to III semester of B.E/B.Tech. Programmes shall attend the classes during the respective semesters to satisfy attendance and CIE requirements and to appear for the University examinations.

(b.1) In case, any student fails to satisfy the attendance requirement of the Courses Additional Mathematics I and II, he/she shall not be eligible to appear for the Semester End Examinations of that semester and shall not be permitted to take admission to next higher semester. The candidate shall be required to repeat that semester during the subsequent year.

(b.2) Students who have satisfied the attendance requirement but not the CIE requirements of the Courses Additional Mathematics I and II shall be permitted to register afresh and appear for SEE after satisfying the CIE requirements in the same Course/s (with or without satisfying the attendance requirement) when offered during subsequent semester/s.
(c) Completion of Additional Mathematics I and II shall be mandatory for the award of degree.

(C) Vertical Progression in case of B.Sc students admitted to Second year (Lateral entry):

(a) Students having not more than four F grades (excluding the Fail or pass status of Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme) in the two semesters of II year of the Programme shall be eligible to move to III year.

(a.1) Students having not more than four F grades (excluding the Fail or pass status of Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme, if any) in the four semesters of II and III year shall be eligible to move to IV year.

(b) The prescribed mandatory non-credit Courses Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme to lateral entry B. Sc holders admitted to III semester of B.E/B. Tech Programmes, shall attend the classes during the respective semesters to complete CIE and attendance requirements and to appear for the University examinations.

(b.1) In case, any student fails to satisfy the attendance requirement of the above said Courses; he/she shall not be eligible to appear for the Semester End Examinations of that semester and shall not be permitted to take admission to next higher semester. The candidate shall be required to repeat that semester during the subsequent year.

(b.2) Students who have satisfied the attendance requirement but not the CIE requirements of the above said Courses, shall be permitted to register afresh and appear for SEE after satisfying the CIE requirements in the same Course/s (with or without satisfying the attendance requirement) when offered during subsequent semester/s.

(c) Completion of Engineering Graphics and Elements of Civil Engineering and Mechanics shall be mandatory for the award of degree.

The Principal of each college shall make suitable arrangements in the timetable to facilitate the B. Sc students to attend the above mentioned courses to satisfy the CIE and attendance requirements and to appear for the University examinations.

11.4 Termination from the programme

A student shall be required to withdraw (discontinue) from the programme and leave the college on the following grounds.

i) Failure to secure a CGPA = 5.0 on three consecutive occasions.

ii) Failure to earn a credit of 175 (135 for lateral entry students) in 8 years (6 years for lateral entry students) of duration from the year of admission including the duration of temporary withdrawal (leave of absence).

iii) Absence from classes for more than six weeks at a time in a semester without leave of absence being granted by competent authorities.

iv) Failure to meet the standards of discipline as prescribed by the college from
time to time.

12. AWARD OF CLASS
Sometimes, it would be necessary to provide equivalence of these averages, viz., SGPA and CGPA with the percentages and/or Class awarded as in the conventional system of declaring the results of University examinations. This can be done by prescribing certain specific thresholds in these averages for Distinction, First Class and Second Class. This can be seen from the following Table.

**Percentage Equivalence of Grade Points (For a 10-Point Scale)**

<table>
<thead>
<tr>
<th>Grade Point</th>
<th>Percentage of Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.75</td>
<td>50 (second class)</td>
</tr>
<tr>
<td>6.25</td>
<td>55</td>
</tr>
<tr>
<td>6.75</td>
<td>60 (First class)</td>
</tr>
<tr>
<td>7.25</td>
<td>65</td>
</tr>
<tr>
<td>7.75</td>
<td>70 (Distinction)</td>
</tr>
<tr>
<td>8.25</td>
<td>75</td>
</tr>
</tbody>
</table>

Percentage = (GPA - 0.75) x 10

13. APPEAL FOR REVIEW OF GRADES

a. The entire process of evaluation shall be made transparent and the course instructor shall explain to a student why he/she gets whatever grade he/she is awarded, if and when required. A mechanism for review of grade is incorporated in the evaluation system. However, before appealing for such review, a student shall first approach the concerned course Instructor and then the concerned DUGC, with the request to do the needful; and only in situations where satisfactory remedial measures have not been taken, the student may then appeal to the Department Academic Appeals Boards (DAAB) before the date specified in Academic Calendar, by paying the prescribed fees.

b. The fee for such an appeal will be decided by the Senate from time to time. If the appeal is upheld by DAAB, then the fee amount will be refunded to the student.

14. AWARD OF DEGREE

14.1 (1) B.E. Degree

a) Students shall be declared to have completed the Programme of B.E./B.Tech. degree and is eligible for the award of degree, provided the students have undergone the stipulated Course work of all the semesters under the Scheme of Teaching and Examinations and has earned the prescribed number of credits (175 credits for regular students registered for 4 year degree programmes & 135 for lateral entry students).

b) For the award of degree, a CGPA≥5.00 at the end of Programme shall be mandatory.
c) Completion of Additional Mathematics I and II, shall be mandatory for the award of degree to lateral entry diploma students.
d) Completion of Engineering Graphics and Elements of Civil Engineering and Mechanics of First Year Engineering Programme shall be mandatory for the award of degree to lateral entry B.Sc. graduates.
e) (i) Over and above the academic credits, every Day College regular student admitted to the 4 years Degree Programme and every student entering 4 years Degree Programme through lateral entry, shall earn 100 and 75 Activity Points respectively through AICTE Activity Point Programme for the award of degree. Students transferred from other Universities/Autonomous colleges under VTU to fifth semester are required to earn 50 Activity Points from the year of entry to VTU. The Activity Points earned shall be reflected on the student’s eight semester Grade Card.
(ii) Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.
In case students fail to earn the prescribed activity Points before the commencement of 8th semester examinations, eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

(2) B.E. (Honors) Degree

VTU, Belagavi has framed the guidelines for applying for the award of Bachelor of Engineering (Honors) degree.

These Regulations are applicable for the following students:

1. Admitted to I semester / I year from the academic year 2018-19 (i.e. USN XXX18XXXXX)
2. Admitted to III semester / II year from the academic year 2019-20 (i.e. USN XXX19XX4XX)
3. These Regulations are uniformly applicable to Affiliated, Autonomous and Constituent Colleges under VTU.

Eligibility criterion

(i) Students have to earn 18 or more additional credits through MOOCs.
(ii) Students shall register for this course from fifth semester onwards.
(iii) Students shall obtain a grade ≥ D in all the courses in first attempt only in all the semesters till 5th.
(iv) Students shall obtain CGPA of 8.5 and above at the end of fourth semester.
(v) For Diploma students, they shall complete Additional Mathematics I and II during 3rd and 4th semesters in first attempt only.

Requirements:

(i) Students shall maintain a grade ≥D in all courses from 5th to 8th semester in ‘first attempt’ only.
(ii) Students not having CGPA greater than or equal to 8.5 at the end of the B.E. programme shall not be eligible for the award of Honors degree, even if they have satisfied the requirement of additional credits.

(iii) Students shall take up additional course work, other than the regular courses prescribed by the University from 5th to 8th semester from NPTEL and other platforms notified by the University and complete the same in any number of attempts with a final score (online assignments: 25 % + Proctored examination: 75 %) leading to the following certificates – ELITE (60 to 75 %) or ELITE + SILVER (76 to 89 %) or ELITE + GOLD (≥ 90 %) before closure of eighth semester as per the academic calendar.

(iv) Students shall be permitted to drop the registered course work (s) and select alternative course work (s) in case they cannot give proctored examination.

(v) Students have to take courses from the list of MOOCs approved by the University, which can be from NPTEL / SWAYAM / other platforms.

(vi) Students shall select courses in consultation with their Class Advisor, such that the content / syllabus of them are not similar to that of the core courses, professional electives or open electives, which the students may chose in the program.

(vii) Students shall earn the additional credits for these courses through MOOCs, by only appearing in person to the proctored examinations conducted by NPTEL / SWAYAM / other platform. The method of assessment shall be as per NPTEL online platform.

(viii) The Credit equivalence shall be as follows - 4 weeks of online course duration – 1 credit, 8 weeks of online course duration – 2 credits and 12 weeks of online course duration – 3 credits.

Registration:

(i) Any student meeting the eligibility criteria and interested to register for Honors degree qualification shall apply to the University through the Principal in the prescribed form along with the prescribed application fees within 15 working days after notification by the University.

(ii) The Registrar shall notify the registration of the student and it will be notified to the student and the student shall pay a one-time, non-refundable registration fees as prescribed by the University to confirm the registration.

Award of Honors Qualification:

(i) Students who successfully complete the MOOCs prescribed by the University and submit their E-certificates to the University through the Principal against the notification issued by the Registrar in time before the closure of eighth semester, as per the academic calendar shall be eligible for B.E. (Honors) degree. If a student does not submit the certificates in time on or before the last date, their request shall not be considered, even if they have earned the requisite number of credits.
(ii) The Honors degree shall be awarded only if the CGPA at the end of the B.E. programme is equal to or greater than 8.5.

(iii) A student who has earned the requisite number of credits and who has submitted the certificates in time and has been accepted by the University will get B.E. degree with Honors suffixed indicating recognition of higher achievement by the student concerned.

(iv) Further students fulfilling all the above requirements shall be entitled to receive their transcripts indicating both the achievement of the student concerned.

(v) The award of the Honors degree shall be recommended by the Academic Senate and approved by the Executive Council of the University.

14.2 (1) Noncompliance of CGPA \( \geq 5.00 \) at the end of the Programme

(a) Students, who have completed all the courses of the Programme but not having a CGPA \( \geq 5.00 \) at the end of the Programme, shall not be eligible for the award of the degree.

(b) In the cases of 14.2 (1) a, students shall be permitted to appear again for SEE in course/s (other than Internship, Technical seminar, Project (Mini and Main), and Laboratories) of any Semester/s without the rejection of CIE marks for any number of times, subject to the provision of maximum duration of the Programme to make up the CGPA equal to or greater than 5.00 for the award of the Degree.

(c) In case, the students earn improved grade/s in all the reappeared course/s, the CGPA shall be calculated considering the improved grade/s. If it is \( \geq 5.00 \), the students shall become eligible for the award of the degree. If CGPA <5.00, the students shall follow the procedure laid in 14.2 (1) b

(d) In case, the students earn improved grade/s in some course/s and the same or lesser than the previously earned pass grade/s in the other reappeared course/s, the CGPA shall be calculated considering the improved grade/s and the pass grades earned before the reappearance. If it is \( \geq 5.00 \), the students shall become eligible for the award of the degree. If CGPA<5.00, the students shall follow the procedure laid in 14.2 (1) b

(e) In case, the students earn improved grade/s in some courses and fail in the other reappeared course/s, the CGPA shall be calculated by considering the improved grade/s and the previously earned pass grade/s of the reappeared course/s in which the students have failed. If it is\( \geq 5.00 \), the students shall become eligible for the award of the degree. If CGPA <5.00, the students shall follow the procedure laid in 14.2 (1) b

(f) In case, the students fail (i.e., earns F grade) in all the reappeared course/s, pass grade/s of the course/s earned by the students before reappearance shall be retained. In such cases, the students shall follow the procedure laid in 14.2 (1) b

(g) Students shall obtain written permission from the Registrar (Evaluation) to reappear in SEE to make up the CGPA equal to or greater than 5.00.
(2) Noncompliance of Mini-project
(a) The mini-project shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the mini-project shall be declared fail in that course and shall have to complete the same during subsequent University examinations after satisfying the Mini-project requirements. Also, mini-project shall be considered for eligibility to VII semester.

(3) Noncompliance of Internship
(a) All the students of B.E/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation. A University examination shall be conducted during VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail in that Course and shall have to complete the same during subsequent University examinations after satisfying the internship requirements.

14.3 The maximum duration for a student for complying to the Degree requirements is 16 – semesters from the date of first registration for his first semester (8 years from the date of admission to first year, (12 semesters / 6 years from the date of admission for lateral entry student)).

15 GRADUATION REQUIREMENTS AND CONVOCATION

15.1 A student shall be declared to be eligible for the award of the degree if he/she has
   a) Fulfilled “Award of Degree” Requirements
   b) No Dues to the College, Departments, Hostels, Library, Central Computer Centre and any other centres
   c) No disciplinary action pending against him/her.

15.2 The award of the degree must be recommended by the Senate

15.3 Convocation

Degree will be awarded for the students who have graduated during the preceding academic year. Students are required to apply for the Convocation along with the prescribed fees, after having satisfactorily completed all the degree requirements (refer ‘Award of Degree’) within the specified date in order to arrange for the award of the degree during convocation.

16 AWARD OF PRIZES, MEDALS, CLASS & RANKS

For the award of Prizes and Medals, the conditions stipulated by the Donor may be considered as per the statutes framed by the College for such awards.

Sometimes, it would be necessary to provide equivalence of these averages, viz., SGPA and CGPA with the percentages and/or Class awarded as in the conventional
system of declaring the results of University examinations. This can be done by prescribing certain specific thresholds in these averages for Distinction, First Class and Second Class as described in 12.

17 **CONDUCT AND DISCIPLINE**

17.1 Students shall conduct themselves within and outside the premises of the College in a manner befitting the students of an Institution of National Importance.

17.2 **As per the order of Honorable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.**

17.3 The following acts of omission/ or commission shall constitute gross violation of the Code of Conduct and are liable to invoke disciplinary measures:

- a) Ragging.
- b) Lack of courtesy and decorum; indecent behaviour anywhere within or outside the campus.
- c) Willful damage or stealthy removal of any property/belongings of the College/Hostel or of fellow students/citizens.
- d) Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs.
- e) Mutilation or unauthorized possession of Library books.
- f) Noisy and unseemly behaviour, disturbing studies of fellow students.
- g) Hacking in computer systems (such as entering into other Person’s area without prior permission, manipulation and/or Damage of computer hardware and software or any other Cyber crime etc.).
- h) Plagiarism of any nature.
- i) Any other act of gross indiscipline as decided by the Senate from time to time.
- j) Use of Mobile in the college Academic area.
- k) Smoking in College Campus and supari chewing.
- l) Unauthorized fund raising and promoting sales.

Commensurate with the gravity of offence the punishment may be: reprimand, expulsion from the hostel, debarring from an examination, disallowing the use of certain facilities of the College, rustication for a specified period or even outright expulsion from the College, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.

17.4 For an offence committed in (i) a hostel (ii) a department or in a class room and (iii) elsewhere, the Chief Warden, the Head of the Department and the Dean (Academics), respectively, shall have the authority to reprimand or impose fine.

17.5 All cases involving punishment other than reprimand shall be reported to the Principal.
17.6 Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Controller of Examinations for taking appropriate action.

18. **EARNING OF ACTIVITY POINTS FOR THE AWARD OF DEGREE**

18.1 As per VTU guidelines, every students entering 4 year degree programme should earn 100 activity points & every students entering 4 year degree programme through Lateral Entry should earn 75 activity points for the award of the Engineering Degree.

18.2 The Activity Points earned will be reflected on the student’s eighth semester Grade Card.

18.3 The activities can be spread over the years (duration of the programme) any time during the semester weekends and holidays, as per the interest & convenience of the students from the year of entry to the programme.

18.4 Activity Points (non-credit) have no effect on SGPA/CGPA point.

18.5 In case students fail to earn the prescribed Activity Points, Eighth semester Grade Card shall be issued only after earning the required Activity Points.

**Note:** Students are required to be inside the examination hall, 20 minutes before the commencement of examination. This is applicable for all examinations (Semester end/Supplementary/makeup) henceforth. Students will not be allowed inside the examination hall after the commencement, under any circumstances.

**********
# LIST OF MAJOR SCHOLARSHIPS

<table>
<thead>
<tr>
<th>Applicable to</th>
<th>Types of scholarship</th>
<th>Method</th>
<th>Website</th>
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<tbody>
<tr>
<td>For SC/ST Students</td>
<td>Income : Below Rs.2,50,000/-</td>
<td>Online application</td>
<td>SSP</td>
</tr>
<tr>
<td>For SC/ST Students</td>
<td>Income : Above Rs.2,50,000/- to Rs.10,00,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For Others</td>
<td>Category I :</td>
<td>Online application</td>
<td></td>
</tr>
<tr>
<td>For Others</td>
<td>Category 2A, 3A, 3B, &amp; GM Income Below Rs.1,00,000/-</td>
<td>Online application</td>
<td></td>
</tr>
<tr>
<td>For Others</td>
<td>Minority students Income Below Rs.2,50,000/-</td>
<td>Online application</td>
<td>NSP &amp; SSP</td>
</tr>
<tr>
<td>Parents must have Beedi Id. Card</td>
<td>Beedi Scholarship</td>
<td>Online application</td>
<td>scholarships.gov.in or nsp.gov.in</td>
</tr>
<tr>
<td>1st year Students</td>
<td>Central Sector Scholarship (MHRD)</td>
<td>Online application</td>
<td>scholarships.gov.in or nsp.gov.in</td>
</tr>
<tr>
<td>1st year Students</td>
<td>AICTE-Pragati.etc</td>
<td>Online application</td>
<td><a href="http://www.aicte-india.org">www.aicte-india.org</a></td>
</tr>
</tbody>
</table>

1. Scholarship details will be published in the notice board near College Academic Section. Students must see the notice board and submit the application before due dates.

2. All SC/ST and Category I students who have not paid any fee in CET must apply for Fee concession or Scholarship. Otherwise they must pay the tuition fee and college fee.

3. The students, who are applying for any of the above scholarship through online, must submit the hardcopy with supporting documents (with attestation) to the academic section in time.
B. E. SYLLABUS

COMPUTER SCIENCE & ENGINEERING

V & VI SEMESTER

With

Scheme of Teaching
& Examination

AY 2021-22
## DEPARTMENT: COMPUTER SCIENCE & ENGINEERING

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Faculty Name</th>
<th>Qualification</th>
<th>Designation</th>
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<tbody>
<tr>
<td>1.</td>
<td>Dr. Niranjan N. Chiplunkar</td>
<td>Ph.D</td>
<td>Professor &amp; Principal</td>
</tr>
<tr>
<td>2.</td>
<td>Dr. Jyothi Shetty</td>
<td>Ph.D</td>
<td>Professor &amp; Head</td>
</tr>
<tr>
<td>3.</td>
<td>Dr. D. K. Sreekantha</td>
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<td>Professor</td>
</tr>
<tr>
<td>4.</td>
<td>Dr. Sarika Hegde</td>
<td>Ph.D</td>
<td>Asso. Prof</td>
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<td>Dr. Venugopala P.S.</td>
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<td>Asso. Prof</td>
</tr>
<tr>
<td>6.</td>
<td>Dr. Roshan Fernandes</td>
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<td>7.</td>
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<tr>
<td>11.</td>
<td>Mr. Raju K</td>
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<tr>
<td>12.</td>
<td>Mr. Pradeep Kanchan</td>
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<td>13.</td>
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<tr>
<td>15.</td>
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<td>Ph.D</td>
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<tr>
<td>16.</td>
<td>Mr. Ganesh Pai</td>
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<tr>
<td>17.</td>
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<tr>
<td>18.</td>
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<td>20.</td>
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<tr>
<td>27.</td>
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<td>28.</td>
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<td>29.</td>
<td>Dr. Shabari Shedthi. B</td>
<td>Ph.D</td>
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<td>30.</td>
<td>Mr. Krishna Prasad Rao</td>
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<td>31.</td>
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<td>32.</td>
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<td>34.</td>
<td>Mr. Shashank Shetty</td>
<td>M.Tech. (Ph.D)</td>
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<td>35.</td>
<td>Mr. Pawan Hegde</td>
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<td>36.</td>
<td>Mr. Sunil Kumar Aithal</td>
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<td>40.</td>
<td>Mrs. Shilpa Karegoudar</td>
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<tr>
<td>41.</td>
<td>Mrs. Anusha Anchan</td>
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<td>42.</td>
<td>Mrs. Joylin Priya Pinto</td>
<td>M.Tech</td>
<td>Asst. Prof Gd I</td>
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<tr>
<td>43.</td>
<td>Mrs. Aishwarya D. Shetty</td>
<td>M.Tech</td>
<td>Asst. Prof Gd I</td>
</tr>
</tbody>
</table>
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

VISION:
To be a center of excellence in Computer science & Engineering education and research, empower the lives of individuals to fulfill their academic excellence, professional passions, and partnership for community development.

MISSION:
- To impart both theoretical and practical knowledge through the state-of-the-art concepts and technologies in Computer Science and Engineering.
- To inculcate values of professional ethics, leadership qualities and lifelong learning.
- To prepare professionals for employment in industry, research, higher education, and entrepreneurship to benefit the society.

Program Educational Objectives (PEOs):
After three years of graduation, our graduates in Computer Science & Engineering should be able to:
1. Apply appropriate theory, practices, and tools to the specification, design, implementation, maintenance, and evaluation of software systems of Computer Science & Engineering in the workplace, for advanced studies or for societal needs.
2. Function effectively in the workplace or maintain employment through lifelong learning such as professional conferences, certificate programs or other professional educational activities, ethics, and societal awareness.
3. Contribute to their computing profession and society by working in teams to design, implement, and/or maintain components of computer software systems.

Program Outcomes (POs):
Engineering Graduates will be able to:
1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**Program Specific Outcomes (PSOs):**

1. **Foundations of Computing:** Apply the knowledge of principles and working of the hardware and/or software aspects of computer systems in the domains of Systems Engineering, Network Engineering, Software Engineering, Data Engineering and Intelligent Systems.

2. **Foundations of Software Design & Development:** Design & develop algorithms, programs, and projects using modern software tools for the solution of engineering problems in the discipline.
### DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

#### SCHEME OF TEACHING AND EXAMINATION

**V SEMESTER B.E.**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Sub. Code</th>
<th>Subject</th>
<th>L + T + P</th>
<th>C.I.E</th>
<th>S.E.E</th>
<th>Credits</th>
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<td>3</td>
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<td>4</td>
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**TOTAL**  450  400  21.5
### SCHEME OF TEACHING AND EXAMINATION

#### VI SEMESTER B.E.

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<th>Sl. No.</th>
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<td>0+2+2</td>
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**TOTAL** | 550 | 500 | 25

43

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<th>PROGRAMMING IN JAVA</th>
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<td>Total Hours  : 50</td>
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<td>Credits      : 4</td>
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Course Learning Objectives:
This Course will enable students to:
1. Learn fundamental features of JAVA language and understand the usage of its programming constructs.
2. Develop and run Java programs by applying the OOPS concepts of java.
3. Create multi-threaded programs and event driven Graphical User Interface (GUI) programming using swing package.
4. Apply the database and networking concepts to develop applications in Java.
5. Design server-side web applications using Java Servlets and JSP.

UNIT – I


(Textbook 1, Chapter – 2-9)  
10 Hours

UNIT – II


(Textbook 1, Chapter – 10, 11, 22)  
10 Hours

UNIT – III

Swings – The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application; Create a Swing Applet; JLabel and ImageIcon; JTextField; The; The Swing Buttons; JTabbedPane; JScrollPane; JList; JComboBox; JTable.

(Textbook 1, Chapter – 10, 11, 19, 22, 23, 24, 29, 30) (Textbook 2 - Chapter4)  
10 Hours
UNIT – IV

Java Database Connectivity (JDBC) - The Vendor Variation Problem, SQL and Versions of JDBC, creating an ODBC Data Source, Simple Database Access, Modifying the Database Contents, Transactions, Meta Data, Scrollable Result Sets in JDBC 2.0, Modifying Databases via Java Methods. Network Programming with Java - Basic Concepts, Protocols and Terminology, Clients, Servers and Peers, Ports and Sockets, The Internet and IP Addresses, Internet Services, URLs and DNS, TCP, UDP. The InetAddressClass, Using Sockets (TCP and UDP). (Textbook 2 - Chapter 2, 7)

10 Hours

UNIT – V


(Textbook 1- Chapter 17). (Textbook 2-Chapter 8, 9) (Textbook 3- Chapter -10,11)

10 Hours

Course Outcomes:
At the end of the course the student will be able to:

1. Apply the basic concepts of Object-Oriented Programming to develop programs in Java and implement the concepts of inheritance, packages & interfaces.
2. Design programs using exception handling, multithreading and event handling concept of Java to solve complex engineering problems.
3. Develop and implement the application program with GUI using Java swings and make use of the file input/output operation.
4. Implement the database concepts using the JDBC/ODBC connectivity. Experiment with network programming using Java sockets API.
5. Implement collection classes and frameworks for data processing. Build a web application based on the concepts of servlets and JSP.
Table-1: Mapping of COs to PIs, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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<td>L3</td>
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<td>CO4</td>
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<td>CO5</td>
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Table-2: Mapping Levels of COs to POs / PSOs

<table>
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<th>Program Outcomes (POs)</th>
<th>PSOs</th>
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<tr>
<td>CO1</td>
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<td>CO2</td>
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<td>2</td>
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<tr>
<td>CO3</td>
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<td>2</td>
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<tr>
<td>CO4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>2</td>
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3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXTBOOKS:

REFERENCE BOOK:

E-Books / Online Resources:
1. Online course material by Oracle: http://docs.oracle.com/javase/tutorial/index.html
2. https://www.udemy.com/courses/search/?q=java&price=price-free&view=grid
MOOC:
2. NPTEL: www.nptelvideos.com/java/java_video_lectures_tutorials.php

There will be 10 questions of 20 marks each in the question paper divided into 5 units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting one full question from each unit.

<table>
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<th>DATABASE MANAGEMENT SYSTEMS</th>
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<tr>
<td><strong>Course Code</strong> : 19CS502</td>
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<td><strong>Teaching Hours /Week (L: T:P:S)</strong> : 4-0-0-0</td>
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<td><strong>Total Hours</strong> : 50</td>
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</table>

**Course Learning Objectives:**
This Course will enable students to:
1. Understand the concept of databases, and apply Entity-Relationship Modeling for creating and designing databases for the real world scenarios.
2. Develop structured query language (SQL) statements.
4. Understand and apply database design concepts and algorithms.
5. Analyze the issues associated with Transaction Processing and understand NoSQL database concepts for managing big data.

**UNIT – I**

**INTRODUCTION TO DATABASE SYSTEMS:**
Introduction, Characteristics of the Database approach, Actors on the scene, Advantages of using the DBMS approach, Data models, Schemes and Instances, Three Schema Architecture and Data Independence.

**ENTITY-RELATIONSHIP MODEL:**
Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the, ER Design for the COMPANY Database; ER Diagrams, Naming Conventions and Design Issues.
(Refer Text 1)

10 Hours
UNIT – II

RELATIONAL MODEL AND RELATIONAL ALGEBRA:
Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations and Dealing with Constraint Violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION; Additional Relational Operations; Examples of Queries in Relational Algebra; Relational Database Design Using ER- to- Relational Mapping.
(Refer Text 1)
10 Hours

UNIT – III

SQL-THE RELATIONAL DATABASE STANDARD:
SQL Data Definition and Data Types, Specifying Basic Constraints in SQL, Schema Change Statements in SQL; Basic Queries in SQL; More Complex SQL Queries; Insert, Delete and Update Statements in SQL; Additional Features of SQL; Views (Virtual Tables) in SQL; Database Programming: Issues and Techniques; Embedded SQL.
(Refer Text 1)
10 Hours

UNIT – IV

DATABASE DESIGN:
Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form; Properties of Relational Decompositions; Algorithms for Relational Database Schema Design; Multi valued Dependencies and Fourth Normal Form; Join Dependencies and Fifth Normal Form.
(Refer Text 1)
10 Hours

UNIT – V

TRANSACTION MANAGEMENT AND NOSQL DATA MANAGEMENT:
The ACID Properties; Transactions and Schedules; Concurrent Execution of Transactions; Lock- Based Concurrency Control; Performance of Locking; Transaction Support in SQL.

NOSQL DATA MANAGEMENT:
Introduction to NoSQL(T4); Aggregate data models – Aggregates – Key-value and document data models;Consistency-Relaxing consistency --CAP theorem; Introduction to MongoDB(T5), Data types in MongoDB, MongoDB query language (CRUD operations).
(Refer Text 2)
10 Hours
Course Outcomes:
Upon completion of this course, students will be able to:
1. Apply the concepts of Databases, Data Management Systems and ER Modeling to Design a Database.
2. Apply the concepts of Relational Models and Relational Algebra to build database queries.
3. Develop and Examine data base queries using Structured Query Language.
4. Design, Develop and Examine databases by applying the concepts of Normalization and Design algorithms.
5. Outline the issues associated with Transaction Processing and apply the concept of NoSQL databases for managing big data.

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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<tbody>
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<td>1.4.1, 2.1.3, 2.3.2</td>
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Table-2: Mapping Levels of COs to POs / PSOs

<table>
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<tr>
<th>COs</th>
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<th>PSOs</th>
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<tr>
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<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
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<td>1 2 3</td>
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<tr>
<td>CO5</td>
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</table>

3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

TEXTBOOKS:
REFERENCE BOOKS:

E-Books / Online Resources:
3. MOOC:
   1. http://nptel.ac.in/courses/106106093/

There will be 10 questions of 20 marks each in the question paper divided into 5 units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting one full question from each unit.

****************

OPERATING SYSTEMS

<table>
<thead>
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<td>50</td>
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Teaching Hours /Week (L:T:P:S): 4-0-0-0

Course Learning Objectives:
This Course will enable students to:
1. Explain the concepts, principles and services of operating system.
2. Identify fundamental operating system abstractions such as Process, Threads, Files, Semaphores, IPC abstractions and demonstrate them.
3. Assess the benefits of concurrency and synchronization and apply them to write concurrent programs.
4. Analyze basic resource management technologies in job and process scheduling. Use and compare different memory management techniques.
5. Study Linux Operating System in terms of process scheduling, Memory management, File system and I/O.
UNIT – I

INTRODUCTION TO OPERATING SYSTEMS, SYSTEM STRUCTURES:

UNIT – II

CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Thread scheduling, Multiple-Processor scheduling. Process Synchronization: The Critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Monitors, Classical problems of synchronization. Deadlocks: System model; Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, avoidance, detection and recovery from deadlock. 10 Hours

UNIT – III

MEMORY MANAGEMENT:
Main Memory: Paging, Structure of page table, Swapping. Virtual Memory: Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing. 8 Hours

UNIT – IV


UNIT – V

**Course Outcomes:**
Upon completion of this course, students will be able to:
1. **Recognise** the structural components of operating system and **describe** a process, its state and process of its creation and termination.
2. **Illustrate** critical section problem and **demonstrate** the Peterson’s solution. **Investigate** the Deadlock condition and **determine** the solution to avoid.
3. **Summarize** Main memory and Virtual Memory allocation methods and **prepare** a page replacement schedule to the given set of page requirement request.
4. **Illustrate** Storage Device management and **classify** file systems based on operations and implementations.
5. **Identify** threat and defence systems with respect to Operating Systems and **associate** principles of protection and access control methods to achieve goals of operating system protection.

**TEXTBOOK:**

**REFERENCE BOOKS:**

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom’s Taxonomy Level (BTL)</th>
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Table-2: Mapping Levels of COs to POs / PSOs

<table>
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<th>COs</th>
<th>Program Outcomes (POs)</th>
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E-Books / Online Resources:

MOOC:
2. https://www.cse.iitb.ac.in/~mythili/os/

There will be 10 questions of 20 marks each in the question paper divided into 5 units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting one full question from each unit.

******************

ENGINEERING MANAGEMENT

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Teaching Hours /Week (L:T:P:S): 3-0-0-0
SEE Marks: 50

Total Hours: 39
Credits: 03

Course Learning Objectives
This Course will enable students to:
1. Develop basic management knowledge essential to make a managerial career in professional life.
2. Impart some of the crucial and basic knowledge about different forms of business organizations.
3. Explain the basic knowledge of various financial tools of project planning.
4. Describe the basics of managing engineering technology, project evaluation and selection.
5. Create awareness among the engineering students about their social responsibilities and obligations.
UNIT – I

Management: Meaning – Functions of Management
Forecasting – Meaning, Methods of Forecasting (Qualitative methods and Quantitative methods – simple moving average method, weighted moving average method, exponential smoothing method, simple regression model)
Break Even Analysis – Meaning of Break-Even Point, Margin of Safety
Organizing: Meaning, Legal Forms of Organization – Sole Proprietorship, Partnership, Corporation/Company, Co-operatives – Meaning and Features only). 15 Hours

UNIT – II

Project Planning Tools – Gantt (Bar) Charts, Network Analysis – PERT and CPM - Crashing the Project completion duration using network analysis.
Depreciation – Types and Causes, Computing Depreciation (using straight line method only) – Estimation of Sunk Cost. 15 Hours

UNIT – III

Project Evaluation Techniques: Interest Rate Calculations, Simple Interest, Compound Interest, Effective Rate of Interest, Payback Time, Present Worth, Future Worth, Annual Worth Calculations. 9 Hours

Course Outcomes
At the end of the course, students will be able to:
1. **Demonstrate** the basic management skills required for a professional.
2. **Make use of** the managerial knowledge with social accountability.
3. **Apply** the knowledge of managerial skills in analyzing different forms of business situations.
4. **Utilize** the knowledge of personal management, production management, financial management, accounting, marketing in personal & professional life.
5. **Demonstrate** the management of engineering technology, project evaluation and selection.

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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Table-1: Mapping of COs to PIs, POs and BTL
Table-2: Mapping Levels of COs to POs / PSOs

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<th>COs</th>
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</table>

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXTBOOKS:

REFERENCE BOOKS:
4) “Organizational Behaviour”, Stephen P Robbins; Prentice Hall, India.

**************************

EMPLOYABILITY SKILL DEVELOPMENT

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<tr>
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</tbody>
</table>

UNIT – I

Quantitative- Numbers (Odd, even, H.C.F& L.C.M, Square roots& cube roots, Average, Percentage) Analytical/ logical- Numerical logic (next number in series, odd man out) Verbal- Vocabulary (root words, prefix, suffix)
UNIT – II
Quantitative- Ratios & Proportions, Partnership Analytical/ logical- Coded language Verbal- Vocabulary (synonyms)

UNIT – III
Quantitative- Time & work Analytical/ logical- Syllogism Verbal- Vocabulary (antonyms)

UNIT – IV
Quantitative- Pipes & Cistern Analytical/ logical- Direction (N-E-W-S) Verbal- One-word substitution

UNIT – V
Quantitative- Speed Analytical/ Logical- Seating arrangement Verbal- Idiom/phrases

UNIT – VI
Quantitative- Problems on trains Analytical /logical- Blood relations Verbal- Sentence completion

UNIT – VII
Quantitative- Problems on boats & streams Analytical/ logical- Blood relations Verbal- Active & Passive voice

UNIT – VIII
Quantitative- Allegation & Mixtures Analytical/ logical- Statement & Conclusion Verbal- Direct & indirect speech

REFERENCE BOOKS:

EXAMINATION PATTERN:
This course is a mandatory learning course without credits. Continuous internal examination (CIE) consists of 2 internal exams (20 marks each) and tasks (10 marks). There is no semester end examination (SEE). The student will be awarded PP or NP grade as per autonomous regulations.
PROGRAMMING IN JAVA LAB

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Programs related to the concepts discussed in theory are to be implemented in lab. Students need to complete a mini project using the Java programming concepts.

1. Use java program to demonstrate the OOP concepts.
2. Demonstrate the file handling using Java.
3. Implement the java programs that uses the concepts of exception handling, multi-threading.
4. Developing of user interfaces using the swings concepts of Java.
5. Develop Java program to store and retrieve data from database.
6. Java programs to establish network connectivity.
7. Demonstrate the web application development using servlets and JSP

***************

DATABASE MANAGEMENT SYSTEMS LAB

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</table>

1. Design and implementation of SQL queries involving various constructs of SQL as discussed in the Unit-III of the syllabus.
2. Implementation of a mini project that involves a user interface design, database design and design of SQL queries to suit the need of the designed application.

***************

OPERATING SYSTEMS LAB

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PART-A: UNIX Shell Script

1. Write a shell program to find and display largest and smallest of three numbers.
2. Write a shell program to check the number n is divisible by m or not. Where m and n are supplied as command line argument or read from keyboard interactively.
3. Write a shell program to check the year is the leap year or not. Display appropriate message.
4. Write a shell program that takes two file names, checks the permissions for these files are identical and if they are identical, output the common permissions; otherwise output each file name followed by its permission.
5. Write a shell program to display the length of the name and also display first three characters and last three characters in the name in two different lines if the name contains at least 6 characters.
6. Write a shell program to implement simple calculator operations.
7. Write a shell script that accepts filename as arguments. For every filename, it should first check whether it exists in the current directory and then convert its name to uppercase, but only if a file with new name doesn’t exist.
8. Write shell script to determine the length of the string, extract a substring and locate a position of a character in a string.
9. Write a PERL program that prompts user to input the string and a number, and prints the string that many times, with each string on separate line.
10. PERL program to find the sum of digits of an unsigned number passed through argument.

**PART-B: Operating Systems Concepts**

1. Write the program to demonstrate creation of a Child Process using system call fork() and display its process id.
2. Write the program to create five Child Processes using system call fork() and display their ids.
3. Write the program to demonstrate the system calls wait( ) and exit( ).
4. Write a program to implement FCFS Scheduling algorithm to determine average wait time and average turnaround time.
5. Write a program to implement SJF Scheduling algorithm to determine average wait time and average turnaround time.
6. Write a program to implement Round robin Scheduling algorithm to determine average wait time and average turnaround time.
7. Write a program to demonstrate FIFO Page replacement algorithm to determine number of page faults.
8. Write a program to demonstrate LRU Page replacement algorithm to determine number of page faults.
9. Write a program to demonstrate Optimal Page replacement algorithm to determine number of page faults.
10. Write a program to demonstrate Bankers Deadlock avoidance algorithm.

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MACHINE LEARNING

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<td>Credits</td>
<td>:</td>
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</table>

Course Learning Objectives:
This Course will enable students to:
1. Understand the need and basics of machine learning and learn the Decision Tree model.
2. Learn ANN and Genetic Algorithm along with its applications.
3. Explore the various learning algorithms using Supervised Learning.
4. Understand the important aspects of Analytical Learning and difference between Analytical and Inductive Learning Algorithms.
5. Analyse the techniques related to reinforcement learning.

UNIT – I

Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version Space and Candidate Elimination Algorithm, Inductive Bias.
*(Text Book-1: Chapter 1 Chapter 2 and Chapter 3)*

10 Hours

UNIT – II

Artificial Neural Networks: Introduction, Neural Network Representations, Appropriate problems, Perceptrons, Back propagation algorithm.
*(Text Book-1: Chapter 4 4.1-4.6 and Chapter 9)*

10 Hours

UNIT – III

Instance Based Learning: k-nearest neighbour learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning.
Bayesian Learning: Bayes theorem, Bayes theorem and concept Learning, Maximum Likelihood, Minimum Description Length, Bayes Optimal Classifier, Gibbs Algorithm, Naive Bayes Classifier, Bayesian Belief Networks, EM Algorithm.
*(Text Book-1: Chapter 8 and Chapter 6)*

10 Hours

UNIT – IV

Analytical Learning: PROLOG-EBG, Explanation Based Learning.
Combining Inductive and Analytical Learning: Inductive – Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis, Alter the Search Objective, Augment Search Operators. *(Text Book-1: Chapter 11 and Chapter 12)*

10 Hours

UNIT – V

Reinforcement Learning:
Learning Task, Q Learning, NonDeterministic Rewards and Actions, Temporal Difference Learning. *(Text Book-1: Chapter 13)*

10 Hours

Course Outcomes:
At the end of the course the student will be able to:
1. Explain the fundamental concept and importance of machine learning, identify, analyze and categorize applications using decision tree algorithm.
2. Demonstrate the application of ANN and Genetic algorithm for real world problems.
3. Design and implement algorithms for supervised learning system.
4. Design and implement algorithms for Analytical and Inductive Learning.
5. Develop machine learning algorithm and reinforcement techniques for real world problems.

<table>
<thead>
<tr>
<th>Table 1: Mapping of COs to Pls, POs and BTL</th>
</tr>
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<tbody>
<tr>
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### Table: Mapping Levels of COs to POs / PSOs

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3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

### TEXTBOOK:

### REFERENCE BOOKS:

### E-Books / Online Resources:
1. [https://in.mathworks.com/](https://in.mathworks.com/)
2. [https://www.kdnuggets.com/](https://www.kdnuggets.com/)
3. [https://blog.cambridgespark.com](https://blog.cambridgespark.com)

### MOOC:
1. [https://www.udemy.com/topic/](https://www.udemy.com/topic/)
2. [https://www.mooc-list.com/](https://www.mooc-list.com/)
3. [https://peltarion.com](https://peltarion.com) (Build and deploy AI with deep learning platform)

There will be **10** questions of **20** marks each in the question paper divided into **5** units as per the syllabi & contact hours and the student will have to answer **5** full questions, selecting **one full** question from **each** unit.
COMPUTER NETWORKS

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Course Learning Objectives:
This Course will enable students to:

1. Outline the principles of computer networks and its application
2. Illustrate the concept of types of network
3. Identify the issues in network layer and solution for it
4. Analyze the process of congestion control algorithms
5. Illustrate IP Packets and fragmentation process.

UNIT – I

Network Layer (Part-I):


10 Hours

UNIT – II

Network layer (Part – II):

10 Hours

UNIT – III

Network layer (Part –III):

10 Hours
UNIT – IV

The Transport Layer:

12 Hours

UNIT – V


8 Hours

Course Outcomes:
Upon Completion of this Course students will be able to:
1. Define Virtual Circuits and Datagram subnets. Classify static and dynamic routing algorithms and identify appropriate routing algorithms from Distance Vector, Link state, flooding, broadcast, multicast for the given requirement.
2. Illustrate the congestion control approaches in the network layer and summarize the QoS achieved by traffic shaping, packet scheduling, admission control.
3. Outline the header format of IPv4 and IPv6 protocols and show the working of OSPF and BGP protocols.
4. Compare UDP and TCP protocols. Examine the working of the Internet Transport Protocol – TCP.
5. Illustrate HTTP, DNS and SMTP application layer protocols

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom’s Taxonomy Level (BTL)</th>
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Table-2: Mapping Levels of COs to POs / PSOs

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<td>CO5</td>
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3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

TEXTBOOKS:

REFERENCE BOOKS:

E-Books / Online Resources:

MOOC:

There will be 10 questions of 20 marks each in the question paper divided into 5 units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting one full question from each unit. **********
**COMPUTER GRAPHICS**

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**Course Learning Objectives:**

This Course will enable students to

1. **Explain** the concepts of application of graphics, **Illustrate** the theory behind the graphics hardware, their **design** and to **differentiate** raster and vector display devices. **Get** the idea of different raster graphics algorithm used and **tell how** they are used by graphics packages.

2. **Illustrate** different geometrical transformations in 2D and 3D and to **make use of** transformations to solve different mathematical problems. **Outline** different color models for raster graphics.

3. **Illustrate** different Fractal Geometry methods, illumination models, shading models for polygons and **find out** the differences between them.

4. **Outline** the theory behind different visible surface algorithms and to **identify** the advantages and disadvantages of a particular technique.

5. **Get** the idea of different openGL functions and to **make use of** openGL libraries for programming different graphical models.

**UNIT – I**

**INTRODUCTION:**
Introduction to graphics, Output Technology: Raster and random scan displays, Video Controller, Applications of Computer Graphics.

**RASTER GRAPHICS ALGORITHM**
Scan converting lines & circles: Midpoint algorithm, Filling Polygons: Scan line filling, Clipping lines: Cohen Sutherland, Clipping polygons: Sutherland-Hodgeman algorithm, Antialiasing.

*(Text book 1: 3.2,3.3,3.6,3.12,3.14 and 3.17)*

**GEOMETRICAL TRANSFORMATIONS (2D):**
2D Transformations, Homogeneous coordinates and Matrix representation of 2D Transformations, composition of 2D Transformations. The window to view port transformation.

*(Text book 1: 5.1 to 5.4)*

15 Hours

**UNIT – II**

**GEOMETRICAL TRANSFORMATIONS (3D):**

*(Text book 1: 5.6 & 5.7)*

**VIEWING IN 3D:**
Types of projections: Perspective and Parallel

*(Text book 1: 6.1)*

**Color Models for Raster Graphics:** RGB,CMY,YIQ,HSV

*(Text Book 1: 13.3)*

**Curves, Fractals and Shading:**
Polygon Meshes, Bezier & B-Spline Curves & Surfaces, Fractal Geometry methods, Illumination models, Shading models

(Text Book 1: 11.1.1, 11.2.2, 11.2.3, 16.1-16.3,16.4.1,16.4.2) 15 Hours

UNIT – III

Visible Surface Determination:
(Text Book 1: 15)

OpenGL:
[Only OpenGL functions] (Text Book 2: 2 except 2.10, 3.1, 3.3,3.8-3.12) 9 Hours

Course Outcomes:
At the end of the course the student will be able to:
1. **Identify** basic graphics, graphic devices and **illustrate** raster graphics algorithms.
2. **Apply** basic mathematical concepts for various geometrical transformations including 2D and 3D.
3. **Design** the curves, fractal and **apply** shading for polygons and **illustrate** different illumination techniques and their properties.
4. **Identify** and **apply** the techniques for various efficient visible surface determination algorithms.
5. **Apply** OpenGL for graphics programming to **design** various graphical models and also to **construct** the real time animations

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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<tr>
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Table-2: Mapping Levels of COs to POs / PSOs

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3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

TEXTBOOKS:

REFERENCE BOOK:

MOOC:
1. https://www.coursera.org/learn/interactive-computer-graphics
2. https://www.mooc-list.com/course/computer-graphics-edx

There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

FORMAL LANGUAGES AND AUTOMATA THEORY

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<tr>
<td>Credits</td>
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</table>
Course Learning Objectives:
This Course will enable students to:

1. Outline the theory behind the basic design of machines, the relation between formal languages and programming languages, and their applications.
2. Make use of regular expressions, find the equivalence between finite automata and regular languages, and identify non-regular languages.
3. Design context-free grammars along with simplification of grammars.
4. Get the idea of designing pushdown automata, find the equivalence between context-free languages and pushdown automata, and identify non-context-free languages.
5. Tell how Turing machines solve any computational process carried by present-day computers, their design, and get the feeling of undecidability concept.

UNIT – I

AUTOMATA:
Why study automata theory, Central concepts of automata theory.

FINITE AUTOMATA:

REGULAR EXPRESSIONS AND LANGUAGES:
Regular expressions, Finite automata and Regular expressions, Applications of regular expressions.

PROPERTIES OF REGULAR LANGUAGES:
Proving languages not to be regular.

(Text Book-1: Chapter 1: 1.1, 1.5; Chapter 2: 2.1 to 2.5; Chapter 3: 3.1, 3.2.2, 3.2.3, 3.3; Chapter 4: 4.1)

UNIT – II

PROPERTIES OF REGULAR LANGUAGES:
Closure properties of regular languages, Equivalence and minimization of automata.

CONTEXT-FREE GRAMMARS AND LANGUAGES:
Context free grammars – Examples and Definitions, More Examples, Derivation Trees and Ambiguity, Unambiguous CFG for algebraic expressions.

PUSHDOWN AUTOMATA
Definition of the Pushdown Automata, Language accepted by a PDA.

(Text Book-1: Chapter 4: 4.2, 4.4; Chapter 6: 6.1, 6.2.1, 6.2.2; Text Book-2: Chapter 6: 6.1, 6.2, 6.4, 6.5)

UNIT – III

PROPERTIES OF CONTEXT-FREE LANGUAGES:
Normal forms for CFGs.

TURING MACHINES:
The Turing machine, Extensions to the Basic Turing Machines.

(Text Book-1: Chapter 7: 7.1; Chapter 8: 8.2, 8.4)

RECURSIVELY ENUMERABLE LANGUAGES
Recursively enumerable languages and Recursive, The Chomsky hierarchy.  
*(Text Book-2: Chapter 10: 10.1, 10.4)*  
9 Hours

**Course Outcomes:**
Upon completion of this course, students will be able to:

1. **Outline** the fundamental understanding of the core concepts in automata theory and formal languages and its applications. **Discover** finite automata for different language classes. **Apply** the procedure to convert deterministic finite automata to non-deterministic finite automata.

2. Find the regular expression for a given language and **illustrate** equivalence between finite automata and regular languages. **Show** the properties of regular languages and minimize the given finite automata.

3. **Discover** context-free grammars for different language classes. **Demonstrate** the ambiguity and unambiguous grammars.

4. **Discover** Pushdown automata for different language classes.

5. **Translate** the context-free grammars from one form to another. **Discover** Turing machines for different language classes. **Explain** the class of languages and their relationship.

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<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
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<th>Table-2: Mapping Levels of COs to POs / PSOs</th>
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3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)
TEXTBOOKS:

REFERENCE BOOKS:

E-BOOKS / ONLINE RESOURCES:

MOOC:
1. http://nptel.ac.in/courses/106106049/

There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

EMPLOYABILITY SKILL DEVELOPMENT

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<th>Course Code</th>
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UNIT- I

Quantitative- Permutations & Combinations
Analytical/ logical- Cause & Effect statements
Verbal- Sentence corrections (Pronoun errors & misplaced modifiers)

UNIT-II

Quantitative- Area, volume & surface areas
Analytical/ logical- Scenario based questions
Verbal- Sentence correction (Parallel construction & Parallel Comparison)

UNIT-III

Quantitative- Profit & loss
Analytical / logical- Figure series & mathematical puzzles
Verbal- Sentence correction (Tense usage)
UNIT-IV
Quantitative- Simple and compound interest Analytical/ logical- Statement & assumption
Verbal- Sentence correction (Subject-verb agreement)

UNIT-V
Quantitative- Logarithms Analytical/ logical- Reasoning analogies Verbal- Verbal analogies

UNIT-VI
Quantitative- Stocks& Shares Data Interpretation-Tables, bar charts Verbal- Reading comprehension (simple passage)

UNIT-VII
Quantitative- Discounts (True discounts, bankers)

REFERENCE BOOKS:

EXAMINATION PATTERN:
This course is a mandatory learning course without credit. Continuous internal examination (CIE) consists of 2 internal exams (20 marks each) and tasks (10 marks). There is no semester end examination (SEE). The student will be awarded PP or NP grade as per autonomous regulations.
MACHINE LEARNING LAB

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PART – A: List of Experiments:
1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Develop a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
5. Develop a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
7. Implement and demonstrate the working of k-Nearest Neighbour algorithm and apply it to classify the iris data set.
8. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
9. Build a model to classify email as spam or ham. First, download examples of spam and ham from Apache Spam Assassin’s public datasets and then train a model to classify email.

PART – B: Mini Project on Machine Learning:
The main goal is to prepare students to apply machine learning algorithms to real-world tasks, or to leave students well-qualified to start machine learning or AI research. The mini project is intended to start in these directions.
Students shall carry out either one of the following three kinds of projects:
1. **Application project.** Pick an application that is of interest and explore how best to apply learning algorithms to solve it.
2. **Algorithmic project.** Pick a problem or family of problems, and develop a new learning algorithm, or a novel variant of an existing algorithm, to solve it.
3. **Theoretical project.** Prove some interesting/non-trivial properties of a new or an existing learning algorithm. (This is often quite difficult, and so very few, if any, projects will be purely theoretical.)

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COMPUTER NETWORKS LAB

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PART A

1. Write a program for simple RSA algorithm to encrypt and decrypt the data.
2. Write a program for error detecting code using CRC-CCITT (16-bits).
3. Write a program for Hamming Code generation for error detection and correction.
4. Write a program for frame sorting technique used in buffers.
5. Using TCP/IP sockets, write a client-server program to make client sending the file name and the server to send back the contents of the requested file if present.
6. Write a program for distance vector algorithm to find suitable path for transmission.
7. Write a program for congestion control using Leaky bucket algorithm.

PART B

1. Simulate a three nodes point-to-point network with duplex links between them. Set the queue size vary the bandwidth and find the number of packets dropped.
2. Simulate a four node point-to-point network, and connect the links as follows: n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets by TCP/UDP.
3. Simulate the different types of Internet traffic such as FTP a TELNET over a network and analyze the throughput.
4. Simulate the transmission of ping mesaged over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
5. Simulate an Ethernet LAN using N-nodes (6-10), change error rate and data rate and compare the throughput.
6. Simulate an Ethernet LAN using N nodes and set multiple traffic nodes and determine collision across different nodes.
7. Simulate an Ethernet LAN using N nodes and set multiple traffic nodes and plot congestion window for different source/destination.

COMPUTER GRAPHICS LAB

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Course Learning Objectives:
This Course will enable students to
1. Demonstrate the implementation of different raster algorithms, clipping algorithms, 2D transformations and 3D models using programming languages like C/C++.
2. Make use of different Open GL API’s and to demonstrate their usage through the graphical models.
3. Propose and develop a graphical mini project using any language.

A. Student has to write and execute programs in C/C++ using OPENGL on Windows/Linux platform to implement a few graphics applications like:
   1. Transformations in both 2D and 3D
   2. Clipping
   3. 3D viewing
   4. Hidden line removal
   5. Fractal generation

B. Student may also be asked to implement one or two graphics algorithms like Line drawing or Circle drawing or Filling by using only graphic primitives.

C. Graphics Mini project implementation
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<th>Group – 1</th>
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<td>System Simulation &amp; Modelling</td>
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<tr>
<td>19CSE52</td>
<td>Signals &amp; Systems</td>
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<tr>
<td>19CSE53</td>
<td>Ad hoc Wireless Networks</td>
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<tr>
<td>19CSE54</td>
<td>Cryptography &amp; Network Security</td>
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<tr>
<td>19CSE55</td>
<td>Blockchain Technology</td>
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<tr>
<td><strong>Intelligent Systems &amp; Analytics</strong></td>
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<td>19CSE72</td>
<td>Pattern Recognition</td>
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<td>19CSE73</td>
<td>Social &amp; Web Analytics</td>
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<td>19CSE74</td>
<td>Neural Network &amp; Deep Learning</td>
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<td>19CSE75</td>
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### Pre-requisite Courses
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<td>Signals &amp; Systems</td>
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<tr>
<td>19CSE54</td>
<td>Cryptography &amp; Network Security</td>
</tr>
<tr>
<td>19CSE82</td>
<td>Image Processing</td>
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### Advanced Courses
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<tr>
<td>19CSE62</td>
<td>Digital Signal Processing</td>
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<tr>
<td>19CSE64, 19CSE55</td>
<td>Cyber Security, and Blockchain Technology</td>
</tr>
<tr>
<td>19CSE72</td>
<td>Pattern Recognition</td>
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PARALLEL ARCHITECTURE AND PROGRAMMING

<table>
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<tr>
<td>Total Hours</td>
<td>39</td>
<td>Credits</td>
<td>3</td>
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</tbody>
</table>

Course Learning Objectives:
This Course will enable students to:
1. Outline the principles of multi-core design and performance measurement
2. Illustrate the concept of parallelization and develop parallel programs
3. Identify the hurdles of parallelization and determine ways to handle these issues
4. Analyse the process of code optimization
5. Recognize the need and usage of multi-threading tools

Course Learning Objectives:
This Course will enable students to
1. Outline the principles of multi-core design.
2. Illustrate the concept of parallelization and develop threaded parallel programs.
3. Develop parallel programs on shared memory and distributed memory parallel computers.
4. Debug and optimize the parallel programs.
5. Develop parallel programs on Graphics Processing Units.

UNIT – I

Introduction to multi-core architecture:
Introduction, Moore’s law, Amdhal’s law, Gustafson’s law, Motivation for Multi-core processors, Types and levels of parallelism, Flynn’s classification of multi-processors, Introduction to parallelization and vectorization: Data dependencies, SIMD technology, Hardware Multithreading vs. Software multi threading, Hyper threading, SMT, Case Study of multi-core processors: Intel, AMD multicore processors. (Chapter-1 and chapter-2 of Textbook-1)

Thread programming: Definition of thread and process, Parallel programming models, Parallel Programming constructs: Synchronization, Deadlock, Critical sections, Threading APIs-POSIX threads. (Chapter-4 Textbook-1) 15 Hours

UNIT – II

Shared and distributed memory parallel programming:
MPI Model: Collective communication, Data decomposition, Communicators and topologies, point-to-point communication, MPI Library, OpenMP: Directives and clauses, environment variables, Programs using OpenMP and MPI. Introduction to intel TBB, Thread-Safeness. (Chapter-4 Textbook-1)

Multithreaded program debugging:
Benchmarks and other performance analysis tools, vTune Performance Analyzer, Thread Checker, Thread Profiler, hotspots, performance issues in algorithms, branch misprediction, cache organization, cache loads, efficiency, hardware and software prefetch. (Chapter-2,3, and 4 of Textbook-2) 15 Hours
UNIT – III

Introduction to GPUs and CUDA programming:
(Chapter-7 Textbook-1) 9 Hours

Course Outcomes:
At the end of the course the student will be able to:
1. Identify the concept of multi-core architecture and motivation behind it.
2. Design parallel program using the multithreading concept.
3. Develop parallel programs using parallel programming frameworks.
4. Describe the concept of multithreaded program debugging.
5. Develop GPU programs using CUDA.

Mapping of POs & COs:

<table>
<thead>
<tr>
<th>POs COs</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
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<td>M</td>
<td>H</td>
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</table>

H : High M: Medium L : Low

TEXTBOOKS:

REFERENCE BOOKS:
1. Multicore programming- Increasing performance through software multithreading,- Shameem Akhter and Jason Roberts, Intel press
EMBEDDED SYSTEMS

Course Code: 19CSE12  CIE Marks: 50
Teaching Hours /Week (L:T:P:S): 3-0-0-0  SEE Marks: 50
Total Hours: 39  Credits: 03

Course Learning Objectives:
This course will enable students to:
1. Explain the concepts and principles of Embedded system design.
2. Identify basic building blocks of an embedded system.
3. Assess the benefits of Intel Atom based embedded system in terms of power consumption,
4. Analyze features of various RTOS.
5. Use Intel Atom boards in typical design of systems.
6. Compare various shared data handling techniques

UNIT – I

Embedded system definition, characteristics, design metrics; Processor, IC and design technologies; Embedded system examples, Digital Camera building blocks, Combinational and sequential building blocks. Use of DSP Processors, SoCs and Microcontrollers in embedded systems. Overview of 8051 microcontroller. Timers, ADCs, Keypad controllers, LCD controllers, stepper motor and DC motor control, Custom Single Purpose processor design examples: GCD Generator, 4-bit multiplier, Communication bridge. Memory – Composing memory, memory hierarchy and Cache memory, interfacing-Serial, Parallel and Wireless Protocols.

15 Hours

UNIT – II

Introduction to Real – Time Operating Systems, features, Examples of RTOS, typical RTOS functions. Interrupt handling and latency, Shared data problems, Tasks and Task States, Task scheduling, Inter-task communication and synchronization, Semaphores, Message Queues, Mailboxes and Pipes, Reentrant functions, Typical software architectures, Embedded Software development and testing tools, JTAG debugger, typical system boot flow diagram. Intel ATOM Processor Architecture, Platform architecture and Micro architecture details.

15 Hours

UNIT – III

Overview of Assembly language programming of ATOM Processor, Low power issues of ATOM processor, ATOM processor series.Intel ATOM Processor kit details, I/O options available, Keyboard and Mouse interface, GPS, GSM and RFID interface – Hands On, Overview of Device drivers.

9 Hours
Course Outcomes:
Upon completion of this course, students will be able to:
1. **Identify** basic building blocks of embedded systems.
2. **Explain** General purpose processor and the purpose of peripherals.
3. **Illustrate** the uses of RTOS.
4. **Explain** different features of real time operating systems.
5. **Design** an embedded system using Intel Atom boards.

### Table 1: Mapping of COs to Pls, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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<tr>
<td>CO1</td>
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### Table 2: Mapping Levels of COs to POs / PSOs

<table>
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<th>COs</th>
<th>Program Outcomes (POs)</th>
<th>PSOs</th>
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<td>CO2</td>
<td>3 2</td>
<td>1 3</td>
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<tr>
<td>CO3</td>
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<td>2 3</td>
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<td>CO4</td>
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<td>2 3</td>
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<tr>
<td>CO5</td>
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<td>3 3</td>
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</table>

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

**TEXTBOOKS:**
REFERENCE BOOKS:

E-Books / Online Resources:

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

***************

OPERATIONS RESEARCH

<table>
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<tr>
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<tr>
<td>Total Hours</td>
<td>39</td>
<td>Credits</td>
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</tbody>
</table>

Course Learning Objectives:
This Course will enable students to:
1. Describe the scope and limitations of OR methods and outline the role of OR techniques in supporting the decisions.
2. Explain the concept of Linear Programming Model (LPM) and formulate Linear Programming problems.
3. Describe the various methods like Simplex Method, revised simplex Method, Big M Method, Two Phase Method, Dual Simplex Method and duality theory and use it on Linear Programming Problems.
4. Describe the formulation of Transportation problems, different methods in Transportation problems like North West Corner Rule, Row minima method, Column minima method, Matrix minima method, Vogel’s approximation method, U-V method and use those methods on the respective real-world problems.
5. Describe the formulation of Assignment problems, use Hungarian method in Assignment problems, CPM and PERT (project management techniques) and use it on the respective real-world problems.

UNIT – I

INTRODUCTION
Introduction to OR, nature and meaning, applications, modeling in OR, phases of OR study

LINEAR PROGRAMMING
Introduction to Linear Programming through an example, graphical method, formulation of LP model from practical problems, assumptions and properties of linear programming,
simplex method, Big M method, 2 phase method, Revised simplex method, Duality theory, Primal and dual relationship.

(Text Book-1: Chapter 2,3,5,6,7,8) 15 Hours

UNIT – II

TRANSPORTATION PROBLEMS
Transportation problems, methods to find initial feasible solution and modification to obtain optimal solution (Degeneracy in transportation problems, unbalanced transportation problems

ASSIGNMENT PROBLEM
Mathematical formulation of an assignment problem, unbalanced assignment problem, Travelling Salesman Problem (TSP), Hungarian method.

(Text Book-1: Chapter 15,16) 15 Hours

UNIT – III

CPM, PERT
Representation of a project by a network, activities and events, starting times, finishing times, floats, slacks, CPM, Idea of crashing probabilistic times and PERT analysis

(Text Book-1: Chapter 31) 9 Hours

Course Outcomes:
At the end of the course the student will be able to:

1. Describe the basics of OR, modelling and applications of OR and the linear programming model.
2. Construct linear programming problem and apply methods like Simplex method, revised simplex method, Big M method, 2 phase method and Dual simplex method to solve the different use cases of linear programming problem.
3. Apply the North West Corner Rule, Row minima method, Column minima method, Matrix minima method, Vogel's approximation method and U-V method to solve the Transportation Problems.
4. Apply the Hungarian method to solve the Assignment Problems and Travelling Salesman Problems.
5. Apply the CPM and PERT project management techniques on the respective use cases to solve the problems related to the use cases.
Table-1: Mapping of COs to PIs, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom’s Taxonomy Level (BTL)</th>
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Table-2: Mapping Levels of COs to POs / PSOs

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<td>3</td>
</tr>
<tr>
<td>CO5</td>
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<td>3</td>
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</table>

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXTBOOK:

REFERENCE BOOKS:

E-Books / Online Resources:
3. http://people.brunel.ac.uk/~mastjjb/jeb/or/contents.html
MOOCs:

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

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CAD FOR VLSI AND VHDL

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</tr>
<tr>
<td>Credits</td>
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</tbody>
</table>

Course Learning Objectives:
This course will enable students to:
1. Explain the VLSI and the fabrication process.
2. Carryout synthesis process
3. Give the algorithmic approach for the fabrication
4. Explain the logical synthesis process.

UNIT - I

OVERVIEW OF VLSI DESIGN:

HIGH LEVEL SYNTHESIS:
Synthesis, Y-chart Partitioning in High level Synthesis, Introduction, Partitioning, Basic Partitioning Methods: Random Selection, Clustering Growth, Hierarchical Clustering

14 Hours

UNIT - II

Data Path Allocation in High level Synthesis, Introduction, Allocation Tasks, Unit Selection, Functional- Unit Binding, Storage Binding, Interconnection Binding, Interdependence and Ordering, Allocation Methods, Greedy Constructive Approaches, Decomposition

16 Hours

UNIT – III

PLAs, Two level optimization PLA Folding, Multilevel logic circuits and Optimization, Physical Synthesis: Floor Planning Placement and Routing, Compaction. VHDL, language constructs, entity and architecture, behavioral description, structural description, examples, Sequential Statements, Testbenches.

9 Hours

Course Outcomes:

Upon completion of this course, students will be able to:

1. **Explain** the concepts and terms related to VLSI design and illustrate high level synthesis.
2. **Select** the synthesis process and process of VLSI circuit.
3. **Apply** the allocation algorithm for the VLSI design.
4. **Illustrate** the logic synthesis process.
5. **Apply** the VLSI method to design and synthesis a real time circuit.

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
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<td>L3</td>
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</table>

Table-1: Mapping of COs to Pls, POs and BTL
Table-2: Mapping Levels of COs to POs / PSOs

<table>
<thead>
<tr>
<th>COs</th>
<th>Program Outcomes (POs)</th>
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<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td>CO5</td>
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</tbody>
</table>

3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

TEXTBOOKS:

REFERENCE BOOKS:

E-BOOKS / ONLINE RESOURCES:

MOOC:
1. https://www.coursera.org/learn/vlsi-cad-logic
2. http://nptel.ac.in/courses/112102101/

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

***********************
INTERNET OF THINGS

Course Code : 19CSE21
CIE Marks : 50
Teaching Hours /Week (L:T:P:S) : 3-0-0-0
SEE Marks : 50
Total Hours : 39
Credits : 03

Course Learning Objectives:
This Course will enable students to:
1. Learn the IoT Definitions, Design aspects
2. Identify the IoT hardware and software requirements
3. Describe IoT logical and physical design concepts
4. Implement Arduino based IoT Projects
5. Implement Raspberry Pi based IoT Projects

UNIT – I

Introduction
Introduction to IoT: Definition and characteristics, Physical design, Logical design, Enabling technologies, Levels and deployment templates, Examples: Domain specific IoTs

IoT Design and System Engineering
Discuss IoT Requirements, Hardware & Software; Study of IoT sensors, Tagging and Tracking, Embedded Products; IoT Design, (U) SIM Card Technology, IoT Connectivity and Management, IoT Security & IoT Communication.

Python Programming
Data types, Data structures, Control flow, Functions, Modules, Packages, File Handling, Date and time operation, Classes, Python packages of IoT
(Text Book-1:, Chapter 1 to 4) 15 Hours

UNIT – II

IoT Logical Design: IoT Physical Design, Basic building blocks, Raspberry Pi, Linux on Raspberry Pi, Interfaces, Programming on Raspberry Pi with Python

Arduino Based IoT Projects Development
Arduino for Project development using components such as LED/Buzzer, Push button/Digital sensor (IR/LDR), Interface motor using relay, Sensing Temperature and Humidity smart phone using Bluetooth.

Raspberry Pi
Raspberry Pi for Project Development: Raspberry Pi platform, GPIO, Establishment and setting, of Raspberry Pi software
(Text Book-1: Chapter 4,5,6,7) 15 Hours

UNIT – III

Raspberry Pi based IoT Project Implementation:
Developing projects using components such as LED/Buzzer, Push button/Digital sensor (IR/LDR), Interface motor using relay, Sensing Temperature and Humidity smart phone using Bluetooth.
(Text Book-1: Chapter 10,11,12,13) 9 Hours
Course Outcomes:
At the end of the course the student will be able to:

1. **Explain** IoT Definitions, Requirements, Systems Design, Sensors, Tags, security communications and **apply** IoT knowledge in understanding IoT systems and applications
2. **Describe** Python basics, Control structures, Functions, Modules, Packages, File Handling, Date and time operation, Classes, Python packages of IoT **Analyze** the and Develop Simple programs using Python
3. **Outline** IoT systems Logical and Physical Design Aspects, Develop Arduino simple programmes for LED, Buzzer, Push button, Digital sensors
4. **Develop and Implement** the simple IoT projects **using** Arduino boards.
5. **Develop and Implement** the simple IoT projects **using** Raspberry Pi boards

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom’s Taxonomy Level (BTL)</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

Table-2: Mapping Levels of COs to POs / PSOs

<table>
<thead>
<tr>
<th>COs</th>
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</table>

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)
TEXTBOOKS:

REFERENCE BOOKS:
1. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra,” Introduction to Internet of Things: A practical Approach”, ETI Labs
4. Adrian McEwen, “Designing the Internet of Things”, Wiley
6. Cuno Pfister, “Getting Started with the Internet of Things”, O Reilly Media

E-Books / Online Resources:
2. Object-Oriented Modeling and Design with UML, James R Rumbaugh, Michael R. Blaha Pearson Education, 21-Nov-2011

MOOC:

LIST OF PRACTICALS
1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when ‘1’/’0’ is received from smartphone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.

SEE SCHEME
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

****************************

**ADVANCED COMPILATION TECHNIQUES**

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</tr>
<tr>
<td>Credits</td>
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**Course Objectives:**
This course will enable students to:
1. Outline issues in compiler design and optimization
2. Bring out the issues in code generation.
3. Perform data flow analysis, Partial-redundancy elimination, Region-based analysis; Symbolic analysis.
4. Perform Basic-block scheduling; Global code scheduling; Software pipelining.
5. Describe instruction level parallelism and optimizing for parallelism.

**UNIT – I**

**Introduction and Review:** Language processors; The structure of a Compiler; The evolution of programming languages; The science of building a compiler; Applications of Compiler technology; Programming language basics.

**Topics in Code Generation:** Issues in the design of Code Generator; Peephole optimization; Register allocation and assignment; Instruction selection by tree rewriting; Optimal code generation for expressions; Dynamic programming code generation.

15 Hours

**UNIT – II**

**Machine-Independent Optimizations:** The principle sources of optimization; Introduction to data flow analysis; Foundations of data flow analysis; Constant propagation; Partial-redundancy elimination; Loops in flow graphs; Region-based analysis; Symbolic analysis.

**Instruction-Level Parallelism:** Process architectures; Code-scheduling constraints; Basic-block scheduling; Global code scheduling; Software pipelining.

15 Hours
UNIT – III

Optimizing for Parallelism and Locality: Basic concepts; An example of matrix multiplication; Iteration spaces; Affine array indexes; Data reuse; Array data – dependence analysis; Finding synchronization-free parallelism; Synchronization between parallel loops; Pipelining; Locality optimizations.

09 Hours

Course Outcomes:
Upon completion of this course, students will be able to:
1. Describe the basic issues in Compiler design and Code generation.
2. Apply the code generation techniques to generate an optimal code for a given high level constructs.
3. Perform flow analysis, Partial-redundancy elimination, Region-based analysis; Symbolic analysis to optimize the code.
4. Construct Basic-block scheduling; Global code scheduling for generating an optimized code.
5. Exploit parallelism and locality concepts for optimizing the given code.

Table-1: Mapping of COs to Pls, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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<tr>
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Table-2: Mapping Levels of COs to POs / PSOs

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</table>

3: Substantial (High)    2: Moderate (Medium)    1: Poor (Low)
TEXTBOOK:

REFERENCE BOOKS:

E-Books / Online Resources:
2. http://infolab.stanford.edu/~ullman/dragon/w06/w06.html

MOOC:
1. http://nptel.ac.in/courses/106108113/
2. https://www.mooc-list.com/course/compilers-coursera

SEE SCHEME
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

ADVANCED ALGORITHMS

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<td>Total Hours</td>
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</table>

Course Objectives:
This course will enable students to:
1. To learn the graph search algorithms.
2. To study about pattern matching and string processing algorithms.
3. To understand the network flow and basic complexity classes of randomized algorithms.

UNIT – I

Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized
Analysis: Aggregate, Accounting and Potential Methods. Graph Algorithms: Bellman-Ford Algorithm; Single source shortest paths in a DAG.

**14 Hours**

**UNIT - II**

Johnson’s Algorithm for sparse graphs, String-Matching Algorithms: Naïve string Matching; Rabin-Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer–Moore algorithms.

**15 Hours**

**UNIT – III**

Flow networks and Ford-Fulkerson method; Maximum bipartite matching; Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.

**10 Hours**

**Course Outcomes:**

Upon completion of this course, students will be able to:

1. **Explain** the algorithmic problem solving, algorithm design techniques and standard asymptotic notations. Apply the general procedure of non-recursive and/or recursive algorithms to obtain worst-case running times of algorithms using asymptotic analysis.
2. **Develop** graph search algorithms for solving searching problems in graphs.
3. **Develop** the optimized pattern matching and string processing algorithms to search the given string in a sentence.
4. **Develop** and apply the network flow problems for a given a specific application.
5. **Describe** the probabilistic and randomized algorithms.

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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Table-2: Mapping Levels of COs to POs / PSOs

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<tr>
<td>CO5</td>
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</table>

3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

TEXTBOOKS:

REFERENCE BOOKS:

E-Books / Online Resources:

MOOC:
2. https://onlinecourses.nptel.ac.in/noc17_cs20/preview

SEE SCHEME

There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.
ADVANCED COMPUTER ARCHITECTURE

**Course Code:** 19CSE24  
**CIE Marks:** 50  
**Teaching Hours /Week (L:T:P:S):** 3–0–0–0  
**SEE Marks:** 50  
**Total Hours:** 39  
**Credits:** 03

**Course Learning Objectives:**  
This Course will enable students to:  
1. Outline the preamble of quantitative principles of computer architecture, various parallel computer models and fundamentals of parallel processing  
2. Make use of the concept of pipelining and apply in Linear and Non Linear pipelining processors  
3. Learn how to enhance a MIPS processor's ability by understanding challenges like hazards and techniques like static and dynamic scheduling  
4. Get an idea of Synchronization mechanism in Multiprocessors and Optimizations in Cache and memory.  
5. Summarize the fundamental aspects of Instruction Level Pipelining and utilize in case studies of Itanium and Intel IA-64 Architecture along with the Hardware and Software.

UNIT – I

**FUNDAMENTALS OF COMPUTER DESIGN:**  
Introduction, Classes of Computers, measuring, reporting and summarizing performance, quantitative principles of computer design (Text 1, chapter: 1).

**PARALLEL COMPUTER MODELS:**  
Shared memory multiprocessors, Distributed-Memory multicomputers (Text 3: chap 1.2). Introduction to Parallel processing: Concepts of concurrent and parallel execution, types and levels of parallelism. (Text 2: chapter 3)

**PIPELINING:**  
Introduction, the major hurdle of pipelining- pipeline hazards, How is pipelining implemented. (Text 1, Appendix A). Linear pipeline processors and Non-linear pipeline processors (Text 3, chapter 6).

UNIT – II

**EXPLOITING INSTRUCTION LEVEL PARALLELISM:**  
Concepts and Challenges, Basic compiler techniques for exposing ILP, Reducing branch cost with prediction, overcoming data hazards with dynamic scheduling, hardware based speculation, exploiting ILP using multiple issues and static scheduling, exploiting ILP using Dynamic scheduling, multiple issue and speculation, advanced techniques for instruction delivery and speculation. (Text 1, chapter 2)

**MEMORY HIERARCHY DESIGN:**  
Introduction; review of concepts. Basic six cache optimization. Eleven Advanced optimizations of Cache performance (self-study); Memory technology and optimizations. (Text 1, chapter 5:  5.1,5.2,5.3)

15 Hours

15 Hours
UNIT – III

HARDWARE AND SOFTWARE FOR VLIW AND EPIC:
Introduction: Exploiting Instruction-Level Parallelism Statically; Detecting and Enhancing Loop-Level Parallelism; Scheduling and Structuring Code for Parallelism; Hardware Support for Exposing Parallelism: Predicated Instructions; Hardware Support for Compiler Speculation; The Intel IA-64 Architecture and Itanium Processor; Conclusions. (Text 1, Appendix G)

Course Outcomes:
At the end of the course the student will be able to:
1. **Describe** the principles of computer design using Amdahl’s law, principle of locality and parallelism.
2. **Demonstrate** instruction level parallelism in MIPS processor using instruction pipelining.
3. **Elaborate** how processor performance is enhanced using software and hardware techniques.
4. **Compare** cache optimization techniques and **choose** the suitable one to improve processor performance.
5. **Illustrate** the hardware and software support for VLIW and EPIC with the case study of Intel IA-64 architecture

<table>
<thead>
<tr>
<th>COs</th>
<th>Program Outcomes (POs)</th>
<th>PSOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
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### Table 1: Mapping of COs to PIs, POs and BTL

<table>
<thead>
<tr>
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**3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)**

### TEXTBOOKS:

### REFERENCE BOOKS:

### E-Books / Online Resources:
2. Fundamentals of computer organization and architecture, M Abd-El-Barr and Hesham El-Rewini, Wiley Interscience, 2005
**MOOC:**

1) NPTEL course on Computer Architecture, by Prof. Madhu Mutyam, PACE Laboratory, Department of computer Science and Engineering, Indian Institute of Technology Madras. Online: https://www.youtube.com/watch?v=Tz7kMR-MAuk

2) NPTEL course on Advanced Computer Architecture, by Dr. John Jose, Department of computer Science and Engineering, Indian Institute of Technology Guwahati. Online: https://www.youtube.com/watch?v=6oiKalH7BKU

3) NPTEL course on Parallel computer Architecture, by Dr. Mainak Chaudhuri, Department of Computer Science and Engineering, Indian Institute of Technology Kanpur. Online: https://nptel.ac.in/courses/106/104/106104024/

**SEE Scheme:**

There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

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**ADVANCED UNIX PROGRAMMING**

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<tr>
<td>Total Hours</td>
<td>39</td>
<td>Credits</td>
<td>03</td>
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**Course Objectives:**

This course will enable students to:

1. List the file APIs and design the programs to perform file handling operations.
2. Illustrate the concept of processes and its environment.
3. Implement programs to handle processes in Linux platform.
4. Demonstrate the concepts of signals and timers.
5. Apply inter process communication concept for data exchange between programs.

**UNIT – I**


15 Hours
UNIT – II


15 Hours

UNIT – III

Interprocess communications: Overview of IPC Methods, Pipes, popen, Pclose functions, FIFOs, SOCKETS: Introduction, functions, Client/Server Message Handling Example.

9 Hours

Course Outcomes:
Upon completion of this course, students will be able to:

1. Define and discuss the POSIX standard and different types of files under UNIX platform.
2. Apply various file APIs for developing the file handling programs that can work on UNIX platform.
3. Illustrate the representation of a process and its environment in UNIX and design programs that can use various process APIs for creating and handing the processes in UNIX.
4. Demonstrate the concept of signal and signal handling methods. Use the signal handling APIs for developing programs to handle operating system issues in UNIX platform.
5. Describe the concepts of demon process and inter process communication, design programs to demonstrate the working of inter process communication using suitable APIs of UNIX for achieving the computer communication.

Table-1: Mapping of COs to Pls, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
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<tbody>
<tr>
<td>CO1</td>
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<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

TEXTBOOKS:
1. Terrence Chan, “UNIX System Programming Using C++”, Prentice Hall India, 1999. (Chapters 1, 5, 6, 7, 8, 9, 10)

REFERENCE BOOKS:

E-Books / Online Resources:
2. richard.esplins.org/static/downloads/linux_book.pdf

MOOC
1. http://nptel.ac.in/courses/106101163/56
2. http://nptel.ac.in/courses/106106156/

SEE SCHEME
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

***************
Course Objectives:
This course will enable students to:
1. Apply the mathematical and logical concepts for programming.
2. Explain various Programming paradigms.
3. Identify the specifications of a sequential program.
4. Write simple program using Dafny.
5. Perform program verification using Dafny.

UNIT – I

BACKGROUND AND INTRODUCTION:
Sequential, concurrent, and reactive systems, Programming languages and paradigms, Type systems of programming languages, Assigning meaning to programs, operational semantics denotational semantics, Partial and total correctness, Hoare triples, Logic for Program Design: Propositional Calculus, Predicate Calculus.

MATHEMATICAL AND LOGICAL FOUNDATIONS:
Mathematics for Specification: Sets, Relations, Functions and Sequences. Pre-conditions, Post conditions Loop invariants.

15 Hours

UNIT – II

SPECIFICATION OF PROGRAMS:
Variant functions, the state model of programs, Partial and total correctness, Weakest precondition, Guarded commands, Why functional programming matters, Algebraic data types, Higher order functions.

PROGRAM VERIFICATION USING DAFNY PART-I
Methods and functions, pre and post conditions, Assertions, loop invariants, termination, quantifiers, framing, Binary search—an example.

15 Hours

UNIT - III

PROGRAM VERIFICATION USING DAFNY PART-II:
Predicates, sets, sequences, collections, Lemmas, modules: Declaring a new module, Import and export new module, opening modules.

9 Hours
**Course Outcomes:**
Upon completion of this course, students will be able to:
1. Identify various paradigms related to programming.
2. Build logical and mathematical specifications for program
3. Testing for specifications of the program.
4. Design and write simple Dafny programs and learn basic syntax.
5. Apply advanced Dafny tool for program verification.

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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<table>
<thead>
<tr>
<th>Table-2: Mapping Levels of COs to POs / PSOs</th>
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**TEXTBOOKS:**

**REFERENCE BOOKS:**
E-Books / Online Resources:

MOOC:
1. http://nptel.ac.in/courses/106102013/

SEE SCHEME
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

********************************************************************************

CLOUD COMPUTING

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<td>Credits</td>
<td>:</td>
<td>03</td>
</tr>
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</table>

Course Learning Objectives:
This Course will enable students to:
1. Outline the fundamental ideas behind Cloud computing, and the evolution of the paradigm, its applicability; benefits as well as current and future challenges.
2. Get the basic idea and principles in Datacenter design and Management and find the importance of Virtualization in Cloud.
3. Get the idea of different Cloud deployment models and Cloud Delivery Models and their security issues.
4. Tell how Cloud Computing solves different problems in the present by considering different Cloud Vendors and their Cloud Design architecture.

UNIT – I

Eras of computing, Parallel vs. Distributed Computing, Elements of Parallel Computing- (What is parallel computing, hardware architecture for Parallel processing, approaches to parallel programming, levels of parallelism, Laws of caution). Elements of Distributed Computing- (General concepts and definitions, components of a distributed system, Architectural styles for distributed computing, models for inter-process communication, Technologies for distributed computing-Remote procedure call, Service oriented computing).
Classic data center, its elements, challenges and benefits. Data center management Steps in transitioning to cloud- consolidation, automation, IT as a service.
Cloud computing Architecture: - Introduction, Cloud reference models- (Architecture, Infrastructure/Hardware as a service, Platform as a service, Software as a service), Types
of cloud – (Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds), Economics of cloud, Open challenges.

15 Hours

UNIT – II

Virtualization: – Introduction, characteristics of virtualized environments, taxonomy of virtualization technique- (execution of virtualization, other types of virtualization-Compute, Storage, Network, Desktop, Application). Virtualization and cloud computing, Pros and Cons of virtualization, Technology examples- XEN, VMware, Microsoft Hyper-V.


15 Hours

UNIT – III

The Purpose of Security Monitoring, Transforming an Event Stream, The Need for C.I.A. in Security Monitoring, the Opportunity for MaaS.


9 Hours

Course Outcomes:

Upon completion of this course, students will be able to:
1. Define the concept of cloud computing business need and various networking methods.
2. Express the infrastructure management for cloud environment.
3. Describe the Virtualization at all levels used by XEN, Vmware, Hyper-v
4. Explain the security concepts in cloud computing
5. Practice the case studies of public cloud such as AWS, Google App Engine and private cloud such as Open Stack.

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
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<td>1.4.1, 2.2.1</td>
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Table-2: Mapping Levels of COs to POs / PSOs

<table>
<thead>
<tr>
<th>COs</th>
<th>Program Outcomes (POs)</th>
<th>PSOs</th>
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<tr>
<td>CO5</td>
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</table>

3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

TEXTBOOKS:

REFERENCE BOOKS:

E-Books / Online Resources:

MOOC:
1. http://nptel.ac.in/courses/106106129/28
2. https://www.coursera.org/learn/cloud-computing

SEE SCHEME
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

************************
SOFTWARE TESTING

<table>
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<tr>
<td>Total Hours</td>
<td>39</td>
<td>Credits</td>
<td>03</td>
</tr>
</tbody>
</table>
Course Learning Objectives:
This Course will enable students to:
1. Make students to learn basic principles of testing and the testing life cycle.
2. Use the testing frameworks, process and test management to generate the test plans.
3. Generate the test plans for a business.
4. Demonstrate the use of testing using Selenium Web driver & TestNG framework.
5. Perform defect management and data management.

UNIT – I

Introduction to Testing – Why and What:
Why is testing necessary? What is testing? Role of Tester, Testing and Quality, Overview of STLC.
Software Testing Life Cycle – V Model:
SDLC vs. STLC, different stages in STLC, document templates generated in different phases of STLC, different levels of testing.
Basics Of Test Design Techniques:
Various test categories, test design techniques for different categories of tests. Designing test cases using MS-Excel.

15 Hours

UNIT – II

Test Management:
Documenting test plan and test case, effort estimation, configuration management, project progress management. Use of Testopia for test case documentation and test management, Test Execution.
Defect Management:
Logging defects, defect life cycle, fixing / closing defects. Use of Bugzilla for logging and tracing defects.
Test Data Management:

15 Hours

UNIT – III

Basics of Automation Testing:
Introduction to automation testing, why automation, what to automate, tools available for automation testing.
Basics of Automation Testing Using Selenium:
Introduction to Selenium, using Selenium IDE for automation testing, using Selenium Web driver for automation testing, understanding TestNG framework with Selenium Web driver for automation testing, Introduction to Maven automation tool.

09 Hours
Course Outcomes:
At the end of the course the student will be able to:

1. **Explain** the need for testing, role of tester, association of testing with quality and **apply** four levels of testing to **build** the test plan.

2. **Describe** test categories, test design techniques and test types. **Analyze** requirements, Develop and test the test cases for functional and boundary values test types.

3. **Outline** four phases in test management process, and **apply** this knowledge to test software systems.

4. **Build and Manage** the test data and defects in software systems by **utilizing** the Test data and Defect management procedures.

5. **Summarize** the need for automation testing, types of automation tools. **Develop** and automate test cases for web based applications by **making use of** the Selenium test suit and TestNG framework.

---

**Table-1: Mapping of COs to PIs, POs and BTL**

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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**Table: Mapping Levels of COs to POs / PSOs**

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3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)
TEXTBOOKS:

REFERENCE BOOKS:

E-Books / Online Resources:
4. http://docs.seleniumhq.org/docs/

MOOCs:
1. http://nptel.ac.in/courses/106105150/

**********

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</table>

Course Learning Objectives:
This Course will enable students to:
1. Design static web pages using HTML5 and Cascading Style Sheets (CSS).
3. Develop the server-side script using PHP and introduce AJAX concepts.
4. Design modern web applications using Bootstrap.
5. Develop AngularJS script at the client side
UNIT – I

HTML5:
Overview of HTML5, New features in HTML5, Removed elements from HTML, HTML5 Semantic elements, HTML5 input types, HTML5 new form elements and attributes, HTML5 Video and Audio.

CASCADING STYLE SHEETS (CSS): Introduction, Levels of style sheets, style specification formats, selector forms, Property Value forms, Font properties, List properties, Color, Alignment of Text, The Box model, Background images, The <span> and <div> tags, Conflict resolution.

THE BASICS OF JAVASCRIPT:
Overview, Object orientation and JavaScript, General syntactic characteristics, Primitives, Operations, and Expressions, Screen output and keyboard input, control statements, Object creation and modification, Arrays, Functions, Constructors, Patterns matching using Regular Expressions, Errors in Scripts.

JAVASCRIPT
The JavaScript Execution Environment, The Document object model, Element access in JavaScript, Events and Event handling, Handling events from Body elements, Handling events from Button elements, Handling events from Text Box and Password elements.

UNIT - II

INTRODUCTION TO PHP:
Origins and uses of PHP, Overview of PHP, General syntactic characteristics, Primitives, Operations and Expressions, Output, Control statements, Arrays, Functions, Pattern Matching, Form handling, Files, Cookies, Session tracking, Database access with PHP and MySQL.

INTRODUCTION TO AJAX:
Overview of Ajax, the basics of Ajax, Example programs using GET and POST method.

BOOTSTRAP:

UNIT - III


8 Hours
Course Outcomes:
Upon completion of this course, students will be able to:
1. Design static web pages using HTML5 and Cascading Style Sheets (CSS).
3. Develop the server-side script using PHP and AJAX concepts.
4. Design modern web applications using Bootstrap.
5. Develop interactive AngularJS script at the client side.

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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Table 2: Mapping Levels of COs to POs / PSOs

<table>
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3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

Textbooks:
REFERENCE BOOKS:

E-Books / Online Resources:

MOOCs:
1. http://nptel.ac.in/courses/106106156/2
2. https://www.coursera.org/learn/web-development

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I &Unit – II and 1 full question from Unit – III.

*************************************************************

MOBILE APPLICATION DEVELOPMENT

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<tr>
<td>Total Hours</td>
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<td>Credits</td>
<td>03</td>
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</tbody>
</table>

Course Learning Objectives:
This Course will enable students to:
1. Describe the architecture and overview of android.
2. Develop a mobile application on android platform using UI components and Android Components.
3. Demonstrate data handling in Android Develop a mobile application on android platform using SQLite
4. Build an Android web service.
5. Develop application to demonstrate google map and navigation.

UNIT – I

INTRODUCTION AND OVERVIEW:
Mobility landscape, Mobile platforms, Mobile apps development, Overview of Android Platform, setting up the mobile app development environment along with an emulator in Android Studio, Hello World Example.

USER INTERFACE DESIGNING:
App user interface designing – mobile UI Layout (Layout, View) UI Control (TextView, EditText, Button, ImageButton, ToggleButton, RadioGroup, RadioButton, CheckBox, ProgressBar, Spinner, DayPicker, TimePicker), Draw-able, Menu(Option, Context, Popup).

Textbook1, Chapters: 1, 2, 4) 15 Hours
UNIT – II

ANDROID APPLICATION COMPONENT:

APP FUNCTIONALITY BEYOND USER INTERFACE:
Threads, Async task, Notification, Location Based Service, Telephony and SMS APIs, Text to Speech, Camera.
(Textbook1, Chapters: 4, 5, 10)

15 Hours

UNIT – III

DATA HANDLING:
Shared preferences, mobile databases such as SQLite, and enterprise data access, Android multimedia: Multimedia-audio/video playback and record. Sensors: Location awareness and native hardware access (sensors such as accelerometer and gyroscope).
(Textbook1, Chapters: 6, 9)

9 Hours

Course Outcomes:
At the end of the course the student will be able to:
1. **Understand** the tool like Android Platform and Android Studio Environment to familiarize with android development environment.
2. **Design** the user interface using the Android UI Components and Android Application Components.
3. **Apply** the concepts such as SQLite, shared preference, files, broadcast, notifications, and other APIs for developing the android applications.
4. **Develop** Application using Sensor telephony APIs.
5. **Apply** the google APIs to build location-based app development.

Table-1: Mapping of COs to PIs, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
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<th>Bloom’s Taxonomy Level (BTL)</th>
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<tbody>
<tr>
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CO4

1,2,3,5,6,8,9, 10,11,12

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5.1.2, 6.1.1, 8.1.1,9.1.2,
9.2.1,9.3.1,10.1.2,10.3.1,
11.1.1,11.3.1,12.1.2,12.2.2

L3

CO5

1,2,3,5,6,8,9, 10,11,12

1.4.1.2.1,2.2.2,3.1.1,3.4.2,
5.1.2, 6.1.1, 8.1.1,9.1.2,
9.2.1,9.3.1,10.1.2,10.3.1,
11.1.1,11.3.1,12.1.2,12.2.2

L3

Table-2: Mapping Levels of COs to POs / PSOs

<table>
<thead>
<tr>
<th>COs</th>
<th>Program Outcomes (POs)</th>
<th>PSOs</th>
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<tbody>
<tr>
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<td>CO5</td>
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</table>

TEXTBOOKS:


REFERENCE BOOKS:


E-Books / Online Resources:


MOOC:

1. http://nptel.ac.in/courses/106106156/
2. https://www.youtube.com/watch?v=SYoNOvdZ3M&list=PLonJJ3BVjZW6CtAMbJz1XD8ELUs1KXaTD&index=19

SEE SCHEME

There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit - II and 1 full question from Unit - III.

***************
SOFTWARE ARCHITECTURE

<table>
<thead>
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<th>CIE Marks</th>
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<td>Total Hours</td>
<td>39</td>
<td>Credits</td>
<td>03</td>
</tr>
</tbody>
</table>

**Course Objectives:**
This Course will enable students to:

1. Outline the various architectural influences and its qualities on the organizational requirements.
2. Make use of different case studies to critically evaluate the suitability of a software architecture.
3. Develop the architecture using different architecture styles.
4. Choose the different architectural pattern and design patterns to design the architecture that enhances the architectural capabilities.
5. Document the software architecture to communicate the system evolution strategy to the stakeholder.

**UNIT - I**

**INTRODUCTION:**
The Architecture Business Cycle: Where do architectures come from? Software processes and the architecture business cycle; What makes a “good” architecture? What software architecture is and what it is not; Other points of view; Architectural patterns, reference models and reference architectures; Importance of software architecture; Architectural structures and views *(Text Book-1: Chapter 1: 1.1,1.2,1.3, Chapter 2: 2.1,2.2,2.3,2.4,2.5)*

**QUALITY:** Functionality and architecture; Architecture and quality attributes; System quality attributes; Quality attribute scenarios in practice; Other system quality attributes; Business qualities; Architecture qualities. Achieving Quality: Introducing tactics; Availability tactics; Modifiability tactics; Performance tactics; Security tactics; Testability tactics; Usability tactics. *(Text Book-1: Chapter 4: 4.1, 4.2,4.3,4.4,4.5,4.6,4.7, Chapter 5:5.1,5.2,5.3,5.4,5.5,5.6,5.7).*

**UNIT - II**

**ARCHITECTURAL STYLES AND CASE STUDIES:** Architectural styles; Pipes and filters; Data abstraction and object-oriented organization; Event-based, implicit invocation; Layered systems; Repositories; Interpreters; Process control; Other familiar architectures; Heterogeneous architectures. Case Study: Mobile robotics. *(Text Book-2: Chapter 2: 2.1, 2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10, Chapter 3:3.3)*

**ARCHITECTURAL PATTERNS:** Introduction, Distributed Systems: Broker; Interactive Systems: MVC, Presentation-Abstraction-Control. Adaptable Systems: Microkernel. *(Text Book-2: Chapter 2: 2.1, 2.3,2.4,2.5)*
UNIT – III

DESIGNING AND DOCUMENTING SOFTWARE ARCHITECTURE: Architecture in the life cycle; designing the architecture; Forming the team structure; Creating a skeletal system. Uses of architectural documentation; Views; choosing the relevant views; Documenting a view; Documentation across views. (Text Book-1: Chapter 7: 7.1, 7.2, 7.3, 7.4, Chapter 9: 9.1, 9.2, 9.3, 9.4, 9.5) 9 Hours

Course Outcomes:
At the end of the course the student will be able to:
1. Identify the requirements which influence the architecture and development strategy.
2. Analyze the architecture using different case studies and quality attributes.
3. Recognize architecture styles to design the architecture.
4. Apply different architecture patterns and design patterns to develop architecture that yields the system that has new organizational capabilities and requirements.
5. Describe the different views to document the architecture.

Table-1: Mapping of COs to PIs, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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<td>1.3.1, 2.1.2</td>
<td>L2</td>
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<td>CO4</td>
<td>1, 2, 3</td>
<td>1.4.1, 2.1.2, 3.2.1</td>
<td>L3</td>
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<tr>
<td>CO5</td>
<td>1, 2</td>
<td>1.4.1, 2.1.3</td>
<td>L2</td>
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Table-2: Mapping Levels of COs to POs / PSOs

<table>
<thead>
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<th>COs</th>
<th>Program Outcomes (POs)</th>
<th>PSOs</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>CO5</td>
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<td>3</td>
</tr>
</tbody>
</table>

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)
TEXTBOOKS:

REFERENCE BOOKS:
1. E. Gamma, R. Helm, R. Johnson, J. Vlissides, “Design Patterns- Elements of Reusable Object-Oriented Software “, Addison- Wesley, 1995.

E-Books / Online Resources:
1. http://www.hillside.net/patterns/

MOOC:
1. http://www.nptel.ac.in/syllabus/106104027/
2. https://www.coursera.org/learn/software-architecture

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

********

OBJECT ORIENTED MODELLING AND DESIGN

<table>
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<tr>
<td>Total Hours</td>
<td>:</td>
<td>39</td>
<td>Credits : 03</td>
</tr>
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</table>

Course Objectives:
This course will enable students to:
1. Recall the object-oriented concepts, three pillars of object-orientation and their benefits.
2. Illustrate the various models that can be used to demonstrate the object-oriented design of any real world software systems.
3. Make use of use-cases for interpreting the requirements and develop class diagrams that model both the domain state model and design model of a software system.
4. Examine the dynamic aspects of a software system, model the interaction diagrams to justify those aspects.
5. Relate how the UML constructs are used to represent various models.
UNIT – I

Introduction:
What is Object Orientation? What is OO development? OO themes; Evidence for usefulness of OO development; OO modeling history.

Modeling as Design Technique: Modeling; abstraction; The three models. Class Modeling: Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips.

Advanced Class Modeling: Advanced object and class concepts; Association ends; N-ary associations;

(Text Book-1: Chapter 1 to 4.3)

Advanced Class Modeling: Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages; Practical tips.

State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior; Practical tips.

Advanced State Modeling: Advanced State Modeling: Nested state diagrams; Nested states; Signal generalization; Concurrency; A sample state model; Relation of class and state models; Practical tips.

Interaction Modeling: Use case models; Sequence models; Activity models; Use case relationships; Procedural sequence models; Special constructs for activity models

(Text Book-1: Chapter 4.4,5,6,7)

15 Hours

UNIT – II

Process Overview, System Conception: Development stages; Development life cycle, Devising a system concept; Elaborating a concept; Preparing a problem statement.

Domain Analysis: Overview of analysis; Domain class model; Domain state model; Domain interaction model; Iterating the analysis.

Application Analysis: Application Analysis: Application interaction model; Application classes model; Application state model; Adding operations.

(Text Book-1: Chapter 10,11,12,13)

System Design: Overview; Estimating performance; Making a reuse plan; Breaking a system in to sub- systems; Identifying concurrency; Allocation of sub-systems; Management of data storage; Handling global resources; Choosing a software control strategy; Handling boundary conditions; Setting the trade-off priorities; Common architectural styles; Architecture of the ATM system as the example.

(Text Book-1: Chapter 14)

15 Hours

UNIT – III

Class Design: Overview of class design; Bridging the gap; Realizing use cases; Designing algorithms; Re-cursing downwards, Re-factorizing; Design optimization; Reification of behavior; Adjustment of inheritance; Organizing a class design; ATM example

Implementation Modeling: Overview of implementation; Fine-tuning classes; Fine-tuning generalizations; Realizing associations; Testing

Legacy Systems: Reverse engineering; Building the class models; Building the interaction model; Building the state model; Reverse engineering tips; Wrapping; Maintenance.

(Text Book-1: Chapter 15,16,17,23)

9 Hours
**Course Outcomes:**
At the end of the course the student will be able to:

1. **Acquire** Knowledge about different software systems modelling techniques, class design and associations by **making use of** concept diagrams
2. **Illustrate** Advanced Class, State and Interaction models of software systems utilizing class, state and interaction diagrams
3. **Outline** the system concepts, Development Life Cycle, **Analyse** and **Define** Problem Statement, **Analyse** the system domain, application, class, state and interaction models
4. **Overview** of system design, **estimate** performance, **divide** it into subsystems, managing resources, selecting appropriate architectural styles
5. **Describe** class design, Implementation modelling, Legacy systems and Reverse engineering concepts, **realizing** use cases, associations, **Fine Tuning** Classes, **Constructing** Interaction and State models.

---

**Table-1: Mapping of COs to PIs, POs and BTL**

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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<td>CO3</td>
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<td>L4</td>
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<tr>
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<td>1.4.1, 2.1.3, 2.2.3, 2.3.2 2.2.1, 2.2.2</td>
<td>L3</td>
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</table>

**Table-2: Mapping Levels of COs to POs / PSOs**

<table>
<thead>
<tr>
<th>COs</th>
<th>Program Outcomes (POs)</th>
<th>PSOs</th>
</tr>
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<tbody>
<tr>
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<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
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</tr>
<tr>
<td>CO1</td>
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<td>CO4</td>
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<td>1 1</td>
</tr>
<tr>
<td>CO5</td>
<td>1 3</td>
<td>1 1</td>
</tr>
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</table>

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)
TEXTBOOK:

REFERENCE BOOKS:

E-Books / Online Resources:
2. Object-Oriented Modeling and Design with UML, James R Rumbaugh, Michael R. Blaha Pearson Education, 21-Nov-2011

MOOC:

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

********************
SYSTEM SIMULATION & MODELLING

Course Code : 19CSE51
CIE Marks : 50
Teaching Hours /Week (L:T:P:S) : 3-0-0-0
SEE Marks : 50
Total Hours : 39
Credits : 03

Course Learning Objectives:

This Course will enable students to:

1. Describe the appropriateness of the simulation, its application, types of simulation model, steps in simulation study and general principles in simulation and concepts in discrete-event simulation.
2. Describe the generation of random numbers and pseudo-random numbers and apply techniques for generating random numbers.
3. Illustrate and apply the techniques of random variate generation, Accept-Rejection techniques and input modelling on relevant exercise problems.
4. Explain the verification, validation and calibration of simulation models.
5. Describe the high-level computer simulation, CPU simulation and memory simulation.

UNIT – I

INTRODUCTION TO SIMULATION:
When Simulation is the Appropriate Tool; When Simulation Is Not Appropriate; Advantages and Disadvantages of Simulation; Areas of Application; Systems and System Environment; Components of a System; Discrete and Continuous Systems; Model of a System; Types of Models; Discrete-Event System Simulation; Steps in a Simulation Study. General Principles: Concepts in Discrete-Event Simulation: The Event-Scheduling / Time-Advance Algorithm, World Views, Manual simulation Using Event Scheduling.
(Text Book-1: Chapter 1, Chapter 3: 3.1)

UNIT – II

RANDOM-NUMBER GENERATION:
(Text Book-1: Chapter 7, Chapter 8: 8.1.1,8.1.2,8.1.7,8.2.1, Chapter 9:9.1,9.2,9.3,9.4,9.6,9.7)

UNIT – III

VERIFICATION AND VALIDATION OF SIMULATION MODELS:
Model Building, Verification and Validation; Verification of Simulation Models; Calibration and Validation of Models. Simulation of Computer Systems: Introduction; Simulation Tools; Model Input; High-Level Computer-System Simulation; CPU Simulation; Memory Simulation.
(Text Book-1: Chapter 10, 14)

9 Hours
**Course Outcomes:**
At the end of the course the student will be able to:

1. Describe the appropriateness of the simulation, its application, types of simulation model, steps in simulation study and general principles in simulation and concepts in discrete-event simulation.
2. Describe the generation of random numbers and pseudo-random numbers and apply techniques for generating random numbers.
3. Illustrate and apply the techniques of random variate generation, Accept-Rejection techniques, input modelling on relevant exercise problems.
4. Illustrate the verification, validation and calibration of simulation models.
5. Illustrate the high-level computer simulation, CPU simulation and memory simulation.

| Table-1: Mapping of COs to Pls, POs and BTL |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| **Course Outcomes (COs)**   | **Program Outcomes (POs) Addressed** | **Performance Indicators (PI)** | **Bloom's Taxonomy Level (BTL)** |
| CO1                         | 1,2                        | 1.4.1, 2.2.2, 2.2.4          | L2                          |
| CO2                         | 1,2                        | 1.1.1, 1.1.2, 1.3.1, 2.1.1,2.1.3,2.2.3,2.2.4.1 | L2, L3                     |
| CO3                         | 1,2                        | 1.1.1, 1.1.2, 1.3.1, 2.1.1,2.1.3,2.2.3,2.2.4.1 | L2, L3                     |
| CO4                         | 1,2                        | 1.4.1, 2.2.2, 2.2.4          | L2                          |
| CO5                         | 1,2                        | 1.4.1, 2.2.2, 2.2.4,2.3.1    | L2                          |

| Table-2: Mapping Levels of COs to POs / PSOs |
|---------------------------------------------|---------------------------------------------|---------------------------------------------|
| **COs** | **Program Outcomes (POs)** | **PSOs** |
|        | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1    | 2 | 3 |   |   |   |   |   |   |   |   |   |   | 3 | 1 |
| CO2    | 3 | 3 |   |   |   |   |   |   |   |   |   |   | 3 | 1 |
| CO3    | 3 | 3 |   |   |   |   |   |   |   |   |   |   | 3 | 1 |
| CO4    | 3 | 3 |   |   |   |   |   |   |   |   |   |   | 3 | 1 |
| CO5    | 3 | 3 |   |   |   |   |   |   |   |   |   |   | 3 | 1 |

3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)
TEXTBOOK:

REFERENCE BOOKS:

E-Books / Online Resources:
1. https://ptolemy.berkeley.edu/books/Systems/PtolemyII_DigitalV1_02.pdf

MOOCs:
2. https://swayam.gov.in

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

***************

SIGNALS AND SYSTEMS

<table>
<thead>
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<th>CIE Marks</th>
<th>SEE Marks</th>
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</tr>
<tr>
<td>3-0-0-0</td>
<td>39</td>
<td>03</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
This course will enable the student to:
1. Explain the concept of signals.
2. Formulate the signal in the form of equations.
3. Represent the signal in Fourier form and apply this.
4. Demonstrate system using differential/difference equation
5. Perform Z transform on the signals.

UNIT – I

INTRODUCTION:
Definitions of a signal and a system, classification of signals, basic operations on signals, elementary signals, systems viewed as interconnections of operations, properties of systems. Time-domain representations for LTI Systems: Convolution, impulse response representation, properties of impulse response representation, differential and difference equation representations, block diagram representations.

15 Hours
UNIT – II

FOURIER REPRESENTATION FOR SIGNALS:
Introduction, Fourier representations for four signal classes, orthogonality of complex sinusoidal signals, DTFS representations, continuous-tine-Fourier-series representations, DTFT and FT representations, properties of Fourier representations. Application of Fourier representations: Frequency response of LTI systems, solution of differential and difference equations using system function, Fourier transform representations for periodic signals, sampling of continuous time signals and signal reconstruction.

15 Hours

UNIT – III

Z-TRANSFORMS
Introduction, Z-transform, properties of ROC, properties of Z-transforms, inversion of Z-transforms, transforms analysis of LTI systems, transfer function, stability and causality, unilateral Z-transforms and its application to solve difference equations

9 Hours

Course Outcomes:
Upon completion of this course, students will be able to:
1. Classify different types of signals and systems.
2. Find the output of a LTI system.
3. Formulate the basic operations on signals.
4. Demonstrate system using differential/difference equation
5. Analyze signals & LTI systems in frequency & Z domain.

Table-1: Mapping of COs to Pls, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom’s Taxonomy Level (BTL)</th>
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<tr>
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<td>1,2</td>
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<td>L2, L3</td>
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<td>1.3.1, 2.1.3, 2.2.4, 2.4.1</td>
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</table>
Table-2: Mapping Levels of COs to POs / PSOs

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</table>

1: Poor (Low)    2: Moderate (Medium)    3: Substantial (High)

TEXTBOOK:
1. Simon Haykin and Barry Van Veen, “Signals and Systems”, John Wiley and Sons, 2001, Reprint 2002(Chapters: 1.1 to 1.8, 2.2 to 2.5, 3.1 to 3.6, 4.2 to 4.3, 4.7, 7.1 to 7.6, 7.8).

REFERENCE BOOKS:

E-Books / Online Resources:

MOOC:
2. https://www.coursera.org/courses/signalsandsystems

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

************************

<table>
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1: Poor (Low)    2: Moderate (Medium)    3: Substantial (High)
ADHOC WIRELESS NETWORKS

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</table>

Course Learning Objectives:
This Course will enable students to:
1. Distinguish the characteristics of ad hoc wireless networks with other wireless networks.
3. Describe and distinguish different types of ad hoc Routing Protocols, TCP over Ad hoc Protocol and a brief introduction to security issues in ad hoc wireless networks.

UNIT – I

Classification of MAC Protocols: Contention based protocols: MACAW, FAMA busy tone protocols, receiver-initiated protocol: MARCH. Contention based protocols with reservation mechanisms: DPRMA, HRMA, FPRP. Contention-based MAC protocols with scheduling mechanism: DPS&MA.

15 Hours

UNIT – II

Table drive routing protocol: DSDV, WRP, CGSR. On-demand routing protocol: DSR, AODV, LAR, FORP.
Hybrid routing protocol: CEDAR, ZRP. Hierarchical routing protocols: FSR. Metrics used by power aware routing protocols.


15 Hours

UNIT – III

routing in Ad hoc wireless Networks: SAR, SEAD, Security-Aware AODV.
Quality of service in Ad hoc wireless Networks: Introduction, Issues & challenges in
providing QoS in Ad hoc wireless Networks, Classification of QoS solutions, MAC layer
solutions, network layer solutions.

**Course Outcomes:**
At the end of the course the student will be able to:

1. **Explain** the wireless networks and MAC layer functionalities.
2. **Identify** and discuss the contention-based MAC protocols and routing protocols of
ad hoc wireless networks.
3. Identify and **interpret** the network protocols that would facilitate the exchange of
data between the wireless networks.
4. **Discuss** the issues related to TCP/IP Transport layer protocols.
5. **Describe** the security and QoS issues and challenges with ad hoc wireless
networks.

**Table 1: Mapping of COs to PIs, POs and BTL**

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom’s Taxonomy Level (BTL)</th>
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<td>L2</td>
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</table>

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

**Table 2: Mapping Levels of COs to POs / PSOs**

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**TEXTBOOKS:**
1. Siva Ram Murthy and B S Manoj, “Ad Hoc Wireless Networks: Architectures and
REFERENCE BOOKS:


E-Books / Online Resources:


MOOC:

2. http://nptel.ac.in/courses/106105160/
3. https://onlinecourses.nptel.ac.in/noc17_cs07/

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

---------------------------------------------

CRYPTOGRAPHY AND NETWORK SECURITY

| Course Code | : | 19CSE54 |
|-------------|:|---------|
| CIE Marks   | : | 50      |
| SEE Marks   | : | 50      |
| Credits     | : | 03      |

Course Learning Objectives:
This Course will enable students to

1. Outline the basic principles of Network security and its applications.
2. Design various block ciphers and design various cryptographic algorithms.
3. Use the theorems needed for cryptographic operations and compare & contrast different types of cryptography.
4. State the concepts & uses of Digital signature and web security.
5. Demonstrate the need and summarize the concept of Secure Electronic Transactions & Intrusion detection system.
UNIT – I

Block Cipher and the Data Encryption Standard: Simplified DES. Block Cipher Principles. The Data Encryption Standard, the Strength of DES, Block Cipher Design Principles, Block Cipher Modes of Operations. Triple DES, Blowfish, Random Number Generation

15 Hours

UNIT – II


15 Hours

UNIT – III


9 Hours

Course Outcomes:
At the end of the course the student will be able to:
1. Identify Explain basic network security model and its applications.
2. Design and Classify various block ciphers and its usages.
3. Apply and Illustrate the concept public key cryptography & apply digital signatures in email processing.
4. Describe different techniques used in key exchange protocols.
5. Apply the knowledge of usages of email-security, IP security and web security.
### Table-1: Mapping of COs to Pls, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
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<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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### Table-2: Mapping Levels of COs to POs / PSOs

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3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

### TEXTBOOKS:

### REFERENCE BOOKS:

### E-Books / Online Resources:
1. [https://wanguolin.github.io/assets/cryptography_and_network_security.pdf](https://wanguolin.github.io/assets/cryptography_and_network_security.pdf)
MOOC:
1. http://nptel.ac.in/courses/106105031/
2. https://www.mooc-list.com/tags/cybersecurity

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

***************

DISTRIBUTED SYSTEMS

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</tbody>
</table>

Course Learning Objectives:
This Course will enable students to:
1. Identify the issues involved in designing distributed systems.
2. Describe various synchronization methods of distributed methods.
3. Analyze process migration approach and distributed deadlock management.
4. Describe features distributed shared memory and file system.
5. List and describe load balancing mechanisms in distributed systems.

UNIT – I


UNIT – II

Synchronization in distributed Systems: Dead locks in distributed systems – distributed deadlock avoidance algorithms – distributed deadlock prevention algorithms, distributed deadlock detection algorithms: Centralized approach, Hierarchical approach and Fully distributed approach.

**UNIT – III**


**Course Outcomes:**
Upon completion of this course, students will be able to:
1. Determine the benefits and issues involved in designing distributed systems.
2. Explain various synchronization methods of distributed methods.
3. Compare various process migration approaches and distributed deadlock management approaches.
4. Apply features of distributed shared memory and file system.
5. Describe load balancing mechanisms in distributed systems.

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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Table-2: Mapping Levels of COs to POs / PSOs

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<th>COs</th>
<th>Program Outcomes (POs)</th>
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3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)
TEXTBOOK:

REFERENCE BOOKS:

E-Books / Online Resources:

MOOC:
1. nptel.ac.in/courses/117102060/

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I &Unit – II and 1 full question from Unit – III.

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DIGITAL SIGNAL PROCESSING

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</table>

Course Learning Objectives:
This course will enable students to:
1. Describe the behavior of discrete time systems in time& frequency domain.
2. Explain and Analyze the FFT algorithms.
3. Analyze the discrete time systems
4. Explain the features of TMS320c25 and TMS32067 processors.
5. Apply the numbering system for problem solving in signal processing.

UNIT – I

THE DISCRETE FOURIER TRANSFORM: ITS PROPERTIES AND APPLICATIONS:

15 Hours

UNIT – II


15 Hours

UNIT – III


9 Hours

Course Outcomes:
After studying this subject, the student should be able to:
1. Analyze the behavior of discrete-time systems in time & frequency domain.
2. Analyze and implement FFT algorithms.
3. Relate theoretical concepts to practical applications.
4. Summarize the working of TMS320c25 and TMS32067 processors.
5. Apply the numbering system for problem solving in signal processing.
Table-1: Mapping of COs to PLs, POs and BTL

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<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
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Table-2: Mapping Levels of COs to POs / PSOs

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3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXTBOOKS:

REFERENCE BOOKS:
E-Books / Online Resources:
1. https://lecturenotes.in/subject/44/digital-signal-processing-dsp

MOOC:
1. http://nptel.ac.in/courses/117102060/

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

ADVANCED COMPUTER NETWORKS

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<tr>
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<td>39</td>
<td>Credits</td>
<td>03</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
This Course will enable students to:
1. Describe the 802.11 wireless LANs and cellular internet access.
2. Explain the Mobile IP and mobility management principles in cellular networks and its impact on higher layer protocols.
3. Describe the network support for multimedia, streaming stored video, Voice-over-IP and protocols for real-time conversational applications.
4. Explain the principles of cryptography, digital signatures, end point authentication, secure e-mail and TCP connections.
5. Describe the IPsec, virtual private networks, security of wireless LANs, firewalls and intrusion detection systems.

UNIT – I

Wireless and Mobile Networks:

UNIT – II

Multimedia and Networking:
UNIT – III

Security in Computer Networks:

9 Hours

Course Outcomes:
At the end of the course the student will be able to:
1. Describe and analyze the 802.11 wireless LANs and cellular internet access.
2. Explain the Mobile IP and mobility management principles in cellular networks and its impact on higher layer protocols
3. Express, Analyze and Evaluate the opportunities and challenges in multimedia data over the network. Apply best protocols and methods towards real problems in multimedia processing.
4. Describe the principles of cryptography, digital signatures, end point authentication, secure e-mail and TCP connections. Identify the necessity cryptography during the transmission of data over the network.
5. Describe the IPsec, virtual private networks, security of wireless LANs, firewalls and intrusion detection systems. Identify the necessity, opportunities and challenges in protecting the data during transmission over the network.

<table>
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<tr>
<th>Course Outcomes (COs)</th>
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<td>CO5</td>
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3: Substantial (High)  
2: Moderate (Medium)  
1: Poor (Low)

TEXTBOOK:

REFERENCE BOOKS:

E-Books / Online Resources:
1. http://etutorials.org
2. https://www.net.t-labs.tu-berlin.de/teaching/computer_networking/

MOOCs:
2. https://www.coursera.org/browse/information-technology/networking

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

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CYBER SECURITY

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<td>Teaching Hours /Week</td>
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<td>SEE Marks</td>
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</tr>
<tr>
<td>Total Hours</td>
<td>39</td>
<td>Credits</td>
<td>03</td>
</tr>
</tbody>
</table>

**Course Learning Objectives:**

This Course will enable students to:

1. Understand the fundamental concepts of cyber security and the attacker techniques and impact.
2. Understand the behavior, types and the impact of malicious code on to the cyber system and the techniques used by the hackers.
3. Understand the various defensive tools and policies need to be followed.

**UNIT – I**

**INTRODUCTION TO COMPUTER SECURITY:**

**CYBER STALKING, FRAUD, AND ABUSE:**
Introduction, How Internet Fraud Works - Investment Offers, Auction Frauds; Identity Theft – Phishing; Cyber Stalking - Laws about Internet Fraud; Protecting Yourself against Cyber Crime - Protecting against Investment Fraud, Protecting against Identity Theft, Secure Browser Settings.

**DENIAL OF SERVICE ATTACKS:**

**UNIT – II**

**MALWARE:**

**TECHNIQUES USED BY HACKERS:**

**INDUSTRIAL ESPIONAGE IN CYBERSPACE:**

15 Hours

UNIT – III

COMPUTER SECURITY SOFTWARE:

SECURITY POLICIES:

9 Hours

Course Outcomes:

Upon completion of this course, students will be able to:
1. Discuss the various threats approaches on the cyber system.
2. Interpret the threat impact on the cyber system.
3. Identify the nature and varying structures of the malicious code and the techniques used by the hackers that is harm to the security.
4. Recognize the defense tools available to protect the cyber systems.
5. Interpret the associated security policies need to be followed.

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom’s Taxonomy Level (BTL)</th>
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<tr>
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<tr>
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<td>L3</td>
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</table>
Table-2: Mapping Levels of COs to POs / PSOs

<table>
<thead>
<tr>
<th>COs</th>
<th>Program Outcomes (POs)</th>
<th>PSOs</th>
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<tr>
<td>CO3</td>
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<td>CO4</td>
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<td>2</td>
</tr>
<tr>
<td>CO5</td>
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<td>2</td>
</tr>
</tbody>
</table>

3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

TEXTBOOK:

REFERENCE BOOKS:

E-BOOKS / ONLINE RESOURCES:
6. https://www.sans.org/security-resources/
7. https://www.springboard.com/blog/free-cybersecurity-resources/
8. https://www.eccouncil.org/free-cybersecurity-resources/
10. http://nptel.ac.in/courses/106105031/39
11. http://nptel.ac.in/courses/106105031/38

MOOC:
1. www.coursera.org/course/inforisk
2. https://www.cyberdegrees.org/resources/free-online-courses/
3. https://swayam.gov.in/nd2_cec20_cs15/preview

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

BLOCKCHAIN TECHNOLOGY

<table>
<thead>
<tr>
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<th>CIE Marks</th>
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<td>SEE Marks</td>
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</tr>
<tr>
<td>Total Hours</td>
<td>39</td>
<td>Credits</td>
<td>3</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
This Course will enable students to:
1. Understand conceptual working of block chain technology.
2. Devise the block chain technology to innovate and improve business processes.
3. Get the idea of working with Ethereum and Smart Contracts in Block Chain Environment.
4. Solving real-world problems using Remix IDE and Truffle.
5. Describe and illustrate the idea of Hyperledger Fabric.

UNIT – I


Consensus: Consensus mechanism, Types of consensus mechanisms, Consensus in blockchain, CAP theorem and blockchain

*(Test Book 1: Chapter 1,6  TextBook 2: Chapter 1)*

15 Hours

UNIT – II


Remix IDE: Programs execution.

*(TextBook 2: Chapter 1,2,9,10 TextBook 3: Chapter 3,4,5,6,9,10)*

15 Hours

UNIT – III

**Hyperledger:** Fabric, The reference architecture, Requirements and design goals of Hyperledger Fabric, Membership services, Blockchain services, Components of the fabric, Chain code implementation, The application model, Consensus in Hyperledger Fabric, The transaction life cycle in Hyperledger Fabric

*(TextBook 2: Chapter 15)*

9 Hours

**Course Outcomes:**
At the end of the course the student will be able to:

1. Explain the block chain technology.
2. Understand the significance of Consensus and working of cryptocurrency.
3. Develop block chain-based solutions and write smart contract using Remix IDE and Ethereum frameworks.
4. Build and deploy block chain application using Truffle Suite.
5. Create and deploy a block chain network using Hyperledger Fabric SDK

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom’s Taxonomy Level (BTL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1,2</td>
<td>1.3.1, 1.4.1, 2.2.1</td>
<td>L2</td>
</tr>
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<td>CO2</td>
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<tr>
<td>CO3</td>
<td>1,2,3</td>
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<td>CO4</td>
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<td>L3</td>
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<td>CO5</td>
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<td>1.4.1, 2.1.3, 3.4.2, 3.4.3</td>
<td>L3</td>
</tr>
</tbody>
</table>
### Table-2: Mapping Levels of COs to POs / PSOs

<table>
<thead>
<tr>
<th>COs</th>
<th>Program Outcomes (POs)</th>
<th>PSOs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO1</td>
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<td>2</td>
</tr>
<tr>
<td>CO2</td>
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</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

### TEXTBOOKS:

### REFERENCE BOOKS:
3. Josh Thomp3ons, “Block Chain: The Block Chain for Beginners-Guide to Block chain Technology and Leveraging Block Chain Programming”.

### MOOC Courses:
1. https://www.coursera.org/specializations/blockchain
2. https://www.edx.org/learn/blockchain
3. https://nptel.ac.in/courses/106/105/106105184/

### SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

**********************************************************************************
ARTIFICIAL INTELLIGENCE

<table>
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<th>CIE Marks</th>
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<td>Total Hours</td>
<td>: 39</td>
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</table>

Course Learning Objectives:

This Course will enable students to:
1. Analyze the most fundamental knowledge to the students so that they can understand what the AI is.
2. Gain a historical perspective of AI and its foundations
3. Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4. Experience AI development tools such as an ‘AI language’, expert system shell, and/or data mining tool.
5. Explore the current scope, potential, limitations, and implications of intelligent systems.

UNIT – I

INTRODUCTION: INTELLIGENT AGENTS
What is AI? Foundation of AI, State of Art, Agents of Environment, Structure of agents.
(Textbook-1: Chapter 1: 1.1 to 1.4 and 2.1 to 2.4)

PROBLEM SOLVING:
Problem solving agents, Example Problems, Searching for solutions, Uniformed and Informed search strategies, Heuristic Functions
(Textbook-1: Chapter 3: 3.1, 3.6), 15 Hours

UNIT – II

UNCERTAIN KNOWLEDGE AND REASONING:
Acting under uncertainty, Basic Probability Notation, Inference using full joint distributions, Bayes Rule and its use.
(Textbook-1: Chapter 13: 13.1, 13.5)

PROBABILISTIC REASONING OVER TIME:
(Textbook-1: Chapter 15: 15.1, 15.3), 15 Hours

UNIT – III

REINFORCEMENT LEARNING:
Introduction, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Applications of Reinforcement Learning.
(Textbook-1: Chapter 21: 21.1 to 21.6) 9 Hours
Course Outcomes:
At the end of the course the student will be able to:
1. Explain the fundamental understanding of the history of artificial intelligence (AI) and its foundation.
2. Interpret the basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
3. Describe the awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4. Identify and explain the proficiency developing applications in an 'AI language', expert system shell, or data mining tool.
5. Determine an ability to share in discussions of AI, its current scope and limitations, and societal implications.

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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<tbody>
<tr>
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Table-2: Mapping Levels of COs to POs / PSOs

<table>
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<th>COs</th>
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<td>CO2</td>
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<tr>
<td>CO3</td>
<td>3 3</td>
<td>3</td>
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<tr>
<td>CO4</td>
<td>3 3 2</td>
<td>3 2</td>
</tr>
<tr>
<td>CO5</td>
<td>3 3 2</td>
<td>3 2</td>
</tr>
</tbody>
</table>

TABLE:
1: Poor (Low)  2: Moderate (Medium)  3: Substantial (High)

TEXTBOOK:
REFERENCE BOOKS:

MOOC:
2. http://nptel.ac.in/courses/106105077/

E-books:

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

***********************

<table>
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</tr>
<tr>
<td>Total Hours          : 39</td>
</tr>
<tr>
<td>Credits              : 03</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
This course will enable students to:
1. Explain the concepts Machine Perception, Pattern Recognition, Design cycle, learning and Bayesian Decision Theory
2. Explain the concepts Machine Perception, Pattern Recognition, Design cycle, learning and Bayesian Decision Theory
3. Perform likelihood estimation, parameter estimation and complex analysis, Demonstrate nearest neighbour rule, metrics and nearest-neighbour classification and fuzzy classification
4. Explain the linear discriminant functions, Perceptron criterion function and squared-error procedures
5. Apply the principles of Learning, clustering, component analysis and multidimensional scaling.
UNIT – I

Introduction: Machine Perception, Pattern Recognition systems, Design cycle, learning and adaptation (1.1, 1.3, 1.4, 1.5 of Ref.1) Bayesian Decision Theory: Introduction, Bayesian Decision theory – continuous features, classifiers, discriminant functions, and decision surfaces, normal density and discriminant functions, Bayes decision theory – discrete features (2.1, 2.2, 2.4, 2.5, 2.6, 2.9 of Ref. 1). Maximum likelihood and Bayesian parameter estimation: Introduction, maximum likelihood estimation, Bayesian Estimation, Bayesian parameter estimation, problem of dimensionality, sufficient and exponential family, complex analysis & discriminants, (3.1 to 3.8 of Ref.1).

15 Hours

UNIT – II

Nonparametric Techniques: Introduction, Density Estimation, Parzen Windows, k-nearest neighbour estimation, nearest neighbour rule, metrics and nearest-neighbour classification, fuzzy classification, reduced coulomb energy, approximations by series expansions (4.1 – 4.9 of Ref.1) Linear discriminant functions: Introduction, linear discriminant functions, generalized linear discriminant functions, minimizing the Perceptron criterion function, relaxation procedures, non-separable behaviours, minimum squared-error procedures, Ho-Kashyap procedures (5.1 to 5.9 of Ref.1).

15 Hours

UNIT – III

Unsupervised learning and clustering: Mixture densities and identifiability, maximum-likelihood estimates, application to normal mixtures, unsupervised Bayesian learning, data decryption and clustering, criterion functions and clustering, hierarchical clustering, on-line clustering. Component analysis, low-dimensional representations and multidimensional scaling (10.1 to 10.14 except 10.8, 10.12 of Ref. 1) Syntactic pattern Recognition: Overview, qualifying structure in pattern description and recognition, grammar-based approach, elements of formal grammar (Chap. 3 of Ref. 2)

9 Hours

Course Outcomes:
Upon completion of this course, students will be able to:

1. Recall the basics of pattern recognition systems and Bayesian Decision Theory.
2. Determine the maximum likelihood and Bayesian parameter estimation.
3. Express the nonparametric techniques such as density estimation and nearest neighbour estimation.
4. Examine linear discriminant functions, minimizing the perception criterion function and minimum squared-error procedures.
5. Describe the various unsupervised learning and clustering methods.
### Table 1: Mapping of COs to PIs, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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<tbody>
<tr>
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<td>L2, L3</td>
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<td>CO5</td>
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<td>L2, L3, L4</td>
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</table>

### Table 2: Mapping Levels of COs to POs / PSOs

<table>
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<tr>
<th>COs</th>
<th>Program Outcomes (POs)</th>
<th>PSOs</th>
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<tr>
<td></td>
<td>1  2  3  4  5  6  7  8  9  10 11 12</td>
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<tr>
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<td>CO2</td>
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</tr>
<tr>
<td>CO5</td>
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<td>3  2</td>
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**TEXTBOOKS:**

**REFERENCE BOOKS:**

**E-Books / Online Resources:**

**MOOC:**
1. [https://www.mooc-list.com/tags/pattern-recognition](https://www.mooc-list.com/tags/pattern-recognition)
2. [http://nptel.ac.in/courses/117105101/](http://nptel.ac.in/courses/117105101/)
SEE SCHEME
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

**************************
SOCIAL AND WEB ANALYTICS

<table>
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<th>CIE Marks : 50</th>
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<td>SEE Marks : 50</td>
</tr>
<tr>
<td>Total Hours</td>
<td>: 39</td>
<td>Credits : 03</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
This course will enable students to:

1. Understand social media, web and social media analytics, and their potential impact.
2. Determine how to Leverage social media for better services and Understand usability metrics, web and social media metrics
3. Use various data sources and collect data relating to the metrics and key performance indicators
4. Identify key performance indicators for a given goal, identify data relating to the metrics and key performance indicators
5. Use ready-made web analytics tools (Google Analytics) and be able to understand a statistical programming language (R), also use its graphical development environment (Deduce) for data exploration and analysis.

UNIT – I

Introduction to web and social analytics: Overview of web & social media (Web sites, web apps, mobile apps and social media), Impact of social media on business, Social media environment, How to leverage social media for better services, Usability, user experience, customer experience, customer sentiments, web marketing, conversion rates, ROI, brand reputation, competitive advantages.

Need of using analytics, Web analytics technical requirements., current analytics platforms, Open Source vs licensed platform, choosing right specifications & optimal solution, Web analytics and a Web analytics 2.0 framework (clickstream, multiple outcomes Relevant Data And its Collection using statistical Programming language R.:Data (Structured data, unstructured data, metadata, Big Data and Linked Data), Participating with people centric approach, Data analysis basics (types of data, metrics and data, descriptive statistics, comparing, Basic overview of R:R-Data Types, R-Decision Making, R-Loops, R-functions, R-Strings, Arrays, R-Lists, R-Data Frame, R-CSV Files, R-Pie Charts, R-Bar charts, R-Barplots. Basic Text Mining in R and word cloud.

15 Hours
UNIT – II

Kpi/Metrics: Understand the discipline of social analytics, Aligning social objectives with business goals, Identify common social business objectives, developing KPIs; Standard vs Critical metrics. PULSE metrics (Page views, Uptime, Latency, Seven-day active users) on business and technical Issues, HEART metrics (Happiness, Engagement, Adoption, Retention, and Task success) on user behaviour issues; Bounce rate, exit rate, conversion rate, engagement, strategically aligned KPIs, Measuring Macro & micro conversions, On-site web analytics, off-site web analytics, the goal-signal-metric process. Case study on Ready-made tools for Web and social media analytics (Key Google Analytics metrics, dashboard, social reports, Tableau Public and KNIME
Mining Twitter: Exploring Trending Topics, Discovering What People Are Talking About, and More: Why Is Twitter All the Rage?, Exploring Twitter’s API, Fundamental Twitter Terminology, Creating a Twitter API Connection, Exploring Trending Topics, Searching for Tweets, Analyzing the 140 Character, Extracting Tweet Entities, Analyzing Tweets and Tweet Entities with Frequency Analysis, Computing the Lexical Diversity of Tweets, Examining Patterns in Retweets, Visualizing Frequency Data with Histograms.
Mining Facebook: Analysing Fan Pages, Examining Friendships, and More: Overview, Exploring Facebook’s Social Graph API, Understanding the Social Graph API, Understanding the Open Graph Protocol, Analyzing Social Graph Connections, Analyzing Facebook Pages, Examining Friendships.

15 Hours

UNIT – III

Data Mining in Social Media :Introduction, Data Mining in a Nutshell, Social Media, Motivations for Data Mining in Social Media, Data Mining Methods for Social Media, Data Representation, Data Mining - A Process, Social Networking Sites: Illustrative Examples, The Blogosphere: Illustrative Examples, Related Efforts, Ethnography and Netnography, Event Maps
Text Mining in Social Networks
Introduction, Keyword Search, Query Semantics and Answer Ranking, Keyword search over XML and relational data, Keyword search over graph data, Classification Algorithms, Clustering Algorithms, Transfer Learning in Heterogeneous Networks

9 Hours

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand social media, web and social media analytics, and their potential impact.
2. Identify and explain ready-made web analytics tools (Google Analytics) and able to understand a statistical programming language (R).
3. Identify key performance indicators for a given goal, identify data relating to the metrics and key performance indicators.
4. Determine how twitter mining can be done for better services.
5. Explain text mining and data mining in social networks.
Table-1: Mapping of COs to PIs, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
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<tbody>
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Table-2: Mapping Levels of COs to POs / PSOs

<table>
<thead>
<tr>
<th>COs</th>
<th>Program Outcomes (POs)</th>
<th>PSOs</th>
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<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
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</tr>
<tr>
<td>CO1</td>
<td>2 2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3 2 3</td>
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<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2 2</td>
<td>2</td>
</tr>
</tbody>
</table>

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXTBOOKS:

REFERENCE BOOKS:
E-Books / Online Resources:


MOOC:

2. http://nptel.ac.in/courses/106106146/21#watch

SEE Scheme:
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

********************

<table>
<thead>
<tr>
<th>NEURAL NETWORKS AND DEEP LEARNING</th>
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<tbody>
<tr>
<td>Course Code</td>
</tr>
<tr>
<td>Teaching Hours /Week (L:T:P:S)</td>
</tr>
<tr>
<td>Total Hours</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
This course will enable students to:
1. Explain the importance and basics of deep learning
2. Outline the structure of neural network and the process of training in neural networks

UNIT – I

Introduction: What is Deep Learning? What are Neural Networks? Neural networks basics: cost functions, hypotheses and tasks; training data; maximum likelihood-based cost, cross entropy, MSE cost; feed-forward networks; MLP, sigmoid units; neuroscience inspiration;

UNIT – II

Neural Networks Training: Learning in neural network: output vs hidden layers; linear vs nonlinear networks; Back propagation: learning via gradient descent; recursive chain rule (backpropagation); if time: bias-variance tradeoff, regularization; output units: linear, softmax; hidden units: tanh, RELU; Deep learning strategies: GPU training, regularization, RLU’s, dropout.

Convolution Neural Networks: Invariance, stability, Variability models (deformation model, stochastic model), Scattering networks, Group Formalism, Properties of CNN representations: invertibility, stability, invariance,
UNIT - III

Covariance/invariance: capsules and related models, Connections with other models: dictionary learning, LISTA, localization, regression, Embeddings (DrLim), inverse problems, Extensions to non-Euclidean domains.

Deep Neural Networks for Sequences: Recurrent Neural Networks: RNN for language modelling and other tasks

Course Outcomes:
Upon completion of this course, students will be able to:
1. Demonstrate the importance and basic of deep learning.
2. Illustrate the various training methods of neural network.
3. Explain the concept of convolution and apply this for neural network design.
4. Explore and develop neural network models
5. Apply Convolution neural networks and recurrent neural networks for real world Problems

9 Hours

Table-1: Mapping of COs to PIs, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom’s Taxonomy Level (BTL)</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1,2</td>
<td>1.1.1, 2.1.3, 2.2.3</td>
<td>L2, L3</td>
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Table-2: Mapping Levels of COs to POs / PSOs

<table>
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<tr>
<th>COs</th>
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<td>CO4</td>
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<tr>
<td>CO5</td>
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<td>3    2</td>
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</table>

3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)
TEXTBOOK:

REFERENCE BOOKS:

E-Books / Online Resources:

MOOC:

SEE SCHEME
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

**********************

BUSINESS INTELLIGENCE

<table>
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<tr>
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<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>39</td>
<td>03</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
This Course will enable students to:
   1. Identify various sources of data and identify the methods to process them.
   2. Explain the ETL process and carryout the ETL process for a given data set.
   3. Design a suitable schema for a given problem.
   4. Illustrate the concepts of data mining.
   5. Demonstrate the Classification and clustering methods.
UNIT – I

INTRODUCTION TO BUSINESS INTELLIGENCE:
Types of digital data – Structured, semi structured and unstructured – sources, characterises, challenges; Introduction to OLTP, OLAP and Data Mining; BI Definitions & Concepts; BI Framework, Who is BI for, BI Users, BI Applications; BI Roles & Responsibilities;
Need for data warehouse – definition, data mart, Approaches for data warehouse, ETL, Basics of Data Integration – approaches, advantages.

Text Book 1 Chapter [2.3-2.5] [(3.1-3.5), (3.8)] [5.1-5.5] [(6.1-6.3), (6.5-6.10)]

15 Hours

UNIT – II

Introduction to data quality, data profiling, Multidimensional data modelling – Basics, types of data model, Concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema; Dimension model life cycle.
Measure, metrics, KPIs and performance management, salient attributes of a good metric, SMART test.
Introduction to enterprise reporting – perspectives, standardization and presentation, balanced scorecards. Concepts of dashboards- types, steps.

Text Book 1 Chapter [6.10-6.12] [7.2-7.8] [(8.2-8.3)] [((9.1-9.2) (9.4-9.7)]

15 Hours

UNIT – III

Data Mining—On What Kind of Data? Data Mining Functionalities—What Kinds of Patterns Can Be Mined? Mining Association rules: Basic concepts, frequent item set mining methods - Apriori Algorithm, Generating Association Rules from Frequent Item sets.

Text Book 2: Chapter [1.1-1.4][6.1-6.2(6.2.1-6.2.4)]

9 Hours

Course Outcomes:
At the end of the course the student will be able to:

1. Identify the sources of data based on its type for a business application and apply OLTP, OLAP operations. (L3)
2. Apply the knowledge of BI operation to determine various roles in a BI application and design the ETL process for handling the data from a given application. (L3)
3. Relate the data warehousing concepts for a real time business application to model a star, snowflake schema for a multi-dimensional data of a given problem. (L3)
4. Explain data quality and profiling methods, identify the quality of the data using data profiling techniques. Apply the measures and metrics to the data to design an enterprise report. (L3)
5. Apply the concepts of mathematics and computer algorithm to illustrate the data mining concepts using association rules. (L2)
Table-1: Mapping of COs to PIs, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes (POs)</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level</th>
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Table-2: Mapping Levels of COs to POs / PSOs

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<th>COs</th>
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<th>PSOs</th>
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<tr>
<td></td>
<td>1  2  3  4  5  6  7  8  9  10  11  12</td>
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<tr>
<td>CO1</td>
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<td>1  1  1</td>
</tr>
<tr>
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<td>1  2  3</td>
<td>1  1  1</td>
</tr>
<tr>
<td>CO3</td>
<td>1  2  3</td>
<td>1  1  1</td>
</tr>
<tr>
<td>CO4</td>
<td>1  2  2</td>
<td>1  1  1</td>
</tr>
<tr>
<td>CO5</td>
<td>2  3</td>
<td>1  1  1</td>
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</table>

3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

TEXTBOOKS:

REFERENCE BOOKS:

E-Books / Online Resources:
MOOC:
1. http://nptel.ac.in/courses/110104086/13

SEE SCHEME
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

*******************************
BIG DATA ANALYTICS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CIE Marks</th>
<th>SEE Marks</th>
<th>Credits</th>
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<td>03</td>
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</table>

Course Learning Objectives:
This Course will enable students to:
1. Study and comprehend in depth the fundamental issues behind Big Data problem.
2. Understand various Big Data technologies, different databases and Hadoop Components.
3. Learn various NoSQL systems and Compare NoSQL systems with other and relational systems.
4. Determine various techniques for analyzing the data such as Pig and Hive.
5. Study and Relate different Analytics associated with Big Data problem.

UNIT – I

The Evolution of Data Management, Understanding the Waves of Managing Data, Creating manageable data structures, Web and content management, Managing big data. Defining Big Data, Building a Successful Big Data Management Architecture, Beginning with capture, organize, integrate, analyze, and act, Setting the architectural foundation, Performance matters, Traditional and advanced analytics.

Chapter 2: Examining Big Data Types and its Sources.
Defining Structured Data Exploring sources of big structured data, Understanding the role of relational databases in big data Defining Unstructured Data, Exploring sources of unstructured data, Understanding the role of a CMS in big data management. Looking at Real-Time and Non-Real-Time Requirements, Putting Big Data Together, Managing different data types, integrating data types into a big data environment.

Chapter 3: Technology Foundations of Big Dat.
Exploring the Big Data Stack:- Layer 0: Redundant Physical Infrastructure - Physical redundant networks, Managing hardware: Storage and servers, Infrastructure operations - Layer 1: Security Infrastructure, Interfaces and Feeds to and from Applications and the

*(Text Book-1: chapter 1,2,4)*

**UNIT – II**

**Chapter 4 : Big Data Management. Introduction to NoSQL, NewSQL**

**Chapter 5 : MapReduce Fundamentals**
Tracing the Origins of MapReduce. Understanding the map Function, Adding the reduce Function Putting map and reduce together. 

*(Text Book-1: Chapter 7,8)*

**UNIT – III**

**Chapter 6 : Hadoop Eco System and Analytics of Big data.**
Explaining Hadoop, Understanding the Hadoop Distributed File System (HDFS) NameNodes. Data nodes, Under the covers of HDFS. Hadoop MapReduce. Getting the data ready, Let the mapping begin. Reduce and combine. Building a Big Data Foundation with the Hadoop Ecosystem, Managing Resources and Applications with Hadoop YARN, Storing Big Data with HBase, Interacting with Pig and Pig latin, Sqoop, Zookeeper.

**Chapter 7: Defining Big Data Analytics.**Basic analytics, Advanced analytics, Operationalized analytics, Monetizing analytics. Modifying Business Intelligence Products to Handle Big Data, Studying Big Data Analytics Examples. 

*(Text Book-1: Chapter 9,10,12)*

**Course Outcomes:**
At the end of the course the student will be able to:

1. **Outline** the theory of big data, and explain applications of big data.
2. **Analyse** the technological foundations for Big data with hadoop and **design** of hadoop distributed file system.
3. **Get** the idea of NoSQL databases, different types of NoSQL/NewSQL datastores.
4. **Understand** the concept of MapReduce workflow.
5. **Understand** the need of Big Data Analytics and **Analyze** Hadoop Ecosystem.
Table-1: Mapping of COs to Pls, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom's Taxonomy Level (BTL)</th>
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<td>L4</td>
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</table>

Table-2: Mapping Levels of COs to POs / PSOs

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<th>COs</th>
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<td>2</td>
</tr>
<tr>
<td>CO5</td>
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<td>3</td>
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</table>

3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

TEXTBOOK:

REFERENCE BOOKS:

E-Books / Online Resources:
MOOCs:
1. https://www.coursera.org/specializations/big-data
2. nptel.ac.in/courses/106104135/48

SEE SCHEME
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

************************

IMAGE PROCESSING

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<td>Total Hours</td>
<td>:</td>
<td>39</td>
<td>Credits</td>
<td>:</td>
<td>03</td>
</tr>
</tbody>
</table>

Course Learning Objectives:
This Course will enable students to:

1. **Outline** the theory behind the basics of digital image processing, the relation between the components of image processing system. **Make use of** Electromagnetic Spectrum, **find** the equivalence between pixels.
2. **Make use of** spatial and frequency domain, smoothing and sharpening filters.
3. **Make use of** Homomorphic Filtering and how to **simplify** Detection of Discontinuities.
4. **Get** the idea of Models Elements of Information, **find** the equivalence between Dilation and Erosion, Opening and Closing, and **identify** the Hit-or-Miss Transformation. **Understand** different compression model.
5. **Tell how** Components of an Image Processing System works, their **design**, and **get** the feeling of Histogram Processing.

**UNIT – I**


**Intensity Transformations and Spatial Filtering** - Background, Some Basic Intensity Transformation Functions, Histogram Processing-Histogram Equalization, Histogram Matching. Local Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

[Text book chapters 1,2,3]

15 Hours
UNIT – II

Filtering in Frequency Domain – Background, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform (DFT) of Functions of one continuous variable, Image smoothing using Frequency-Domain Filters – Ideal Lowpass Filters, Butterworth Lowpass Filters, Gaussian Lowpass Filters, Image Sharpening using Frequency Domain Filters -Ideal Highpass Filters, Butterworth Highpass Filters, Gaussian Highpass Filters, Homomorphic Filtering.
[Text book chapter 4.1,4.3,4.4,4.8,4.9]

[Text book chapter 8.1,8.2]

Morphological Image Processing – Preliminaries, Dilation and Erosion, Opening and Closing, the Hit-or-Miss Transformation, Some Basic Morphological Algorithms -Boundary Extraction, Thinning, Thickening

15 Hours

UNIT- III

Image Segmentation – Point, Line and Edge Detection – Background, Detection of Isolated Points, Line Detection, Edge Model, Basic Edge Detection, Edge Linking and Boundary Detection, Thresholding- Foundation, Basic Global Thresholding, Region Based Segmentation Region growing, splitting and merging.
[Text book chapter 10.1,10.2,10.3,10.4]

9 Hours

Course Outcomes:
Upon completion of this course, students will be able to:

1. Apply the concept of Digital Image Processing and Steps in Digital Image Processing, Able to apply the Knowledge of Image Sampling and Quantization and Illustrate Some Basic Relationships between Pixels using Knowledge of 4-8 and M adjacency.
2. Design and Formulate Histogram processing. Analyze Smoothing Spatial Filters, Sharpening Spatial Filters by applying mathematical knowledge.
3. Explain Frequency domain and illustrate Smoothing Frequency-Domain Filters. Analyze Sharpening frequency-Domain Filters. Apply and Design Image Compression Standards and models.
4. Analyze the concept of Morphological Image Processing by applying mathematical knowledge.
5. Design and Formulate Image segmentation techniques and prove the properties Region-Based Segmentation.
### Table 1: Mapping of COs to PI, POs and BTL

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
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</table>

### Table 2: Mapping Levels of COs to POs / PSOs

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<td>3</td>
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<td>CO4</td>
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<td>3 2</td>
</tr>
<tr>
<td>CO5</td>
<td>2 3</td>
<td>3 2</td>
</tr>
</tbody>
</table>

3: Substantial (High)  2: Moderate (Medium)  1: Poor (Low)

**TEXTBOOK:**


**REFERENCE BOOKS:**


**E-Books / Online Resources:**

1. ititlab.bit.edu.cn/HandbookofImageandVideoProcessing.pdf
MOOC:
1. https://nptel.ac.in/courses/117105079/
2. https://swayam.gov.in/nd1_noc19_ee55/preview
3. https://www.coursera.org/learn/image-processing
4. https://www.coursera.org/learn/image-processing

SEE SCHEME
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

****************************

NATURAL LANGUAGE PROCESSING

<table>
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<th>Course Code</th>
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<th>CIE Marks</th>
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Course Learning Objectives:

This course will enable students to
1. Explain the importance of NLP and breaking of words.
2. Outline the syntax, semantics and pragmatics in speech language.
3. Describe the models for different applications of NLP.

UNIT - I

Knowledge in speech and language processing; Ambiguity; Models and algorithms; Regular expressions - Basic Regular Expression Pattern, Disjunction, Grouping, and Precedence, A Simple Example, A More Complex Example, Advanced Operators(2.1.1 - 2.1.5), Using an FSA to Recognize Sheep-talk, Formal Languages, Another Example, Non-Deterministic FSAs, Using an NFSA to Accept String(2.2.1 - 2.2.5); Words and Transducers - Inflectional Morphology, Derivational Morphology, Cliticization, Non-concatenative Morphology, Agreement(3.1.1 - 3.1.5); Finite-state morphological parsing(3.2); Detecting and correcting spelling errors, Minimum edit distance(3.10 - 3.11), N-Grams - Counting words in corpora, Simple(un-smoothed) n-grams(4.1 - 4.2); Part – of - Speech Tagging - English word classes, tagsets for English(5.1 - 5.2), Hidden Markov Models - Markov chains, The Hidden Markov Model(6.1 - 6.2).

(Refer Text Book 1)

UNIT – II

Syntactic Parsing: Grammars and syntax structure, A top down parser, Depth first strategy vs Breadth first strategy, Bottom up chart parser, Efficiency considerations, Transition Network Grammars, Top down chart parser.

(Refer Text Book 2)

Representing Meaning: Computational desiderata for representations, Meaning structure of language, Model theoretic semantics, First order logic. (17.1 – 17.4)
Computational Semantics: Syntax driven semantic analysis, Semantic augmentations to context-free grammar rules, Quantifier scope ambiguity and under specification, Unification based approaches to semantic analysis. (18.1 – 18.4)


(Refer Text Book 1)

**UNIT – III**


(Refer Text Book 1)

**Course Outcomes:**

Upon completion of this course, students will be able to:

1. **Explain** the understanding of core tasks in NLP.
2. **Demonstrate** the syntax, semantics and pragmatics in speech language.
3. **Implement** and experiment the models for different applications of NLP.
4. **Demonstrate** understanding of state-of-the-art algorithms and techniques for text-based processing of natural language.
5. **Demonstrate** understanding of human languages and be familiar with the most mainstream descriptive and theoretical frameworks for handling their properties.

<table>
<thead>
<tr>
<th>Course Outcomes (COs)</th>
<th>Program Outcomes (POs) Addressed</th>
<th>Performance Indicators (PI)</th>
<th>Bloom’s Taxonomy Level (BTL)</th>
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3: **Substantial** (High)  2: **Moderate** (Medium)  1: **Poor** (Low)
TEXTBOOKS:

REFERENCE BOOKS:

E-Books / Online Resources:

MOOC:
1. https://www.experfy.com/training/courses/natural-language-processing-for-retail

SEE SCHEME
There will be 8 questions of 20 marks each in the question paper divided into 3 Units as per the syllabi & contact hours and the student will have to answer 5 full questions, selecting 2 full questions from Unit - I & Unit – II and 1 full question from Unit – III.

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SOFT COMPUTING

<table>
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Course Learning Objectives:
This Course will enable students to:
1. Differentiate hard and soft computing, Define SC constitutes, List Applications, Outline Intelligent systems architecture
2. Design conceptual GA algorithm, Illustrate Mutation and Cross over operations, define learning strategies, List ML applications, Describe the architecture of learning agent
3. Explain the structure and function of Biological Neuron, discuss MFF networks, represent back propagation
4. Demonstrate fuzzy operations, membership function, compare fuzzy models, derive fuzzy rules, outline Fuzzy inference systems
5. Analyze decision making strategies, list expert system features, tools, explain expert’s system architecture

UNIT – I
Introduction to Soft Computing:
Genetic Algorithms:
(Text Book-1: Chapter 1.1 to 1.3)(Text Book-3: Chapter 1)
(Text Book -4: Chapter 1 and 2)
15 Hours

UNIT – II
NEURAL NETWORKS:
Introduction to Neural Networks, Applications, Structure and function of Biological Neuron, ANN introduction, Perceptron, Multi-layer feed forward Networks with Back propagation
FUZZY LOGIC:
(Text Book-1: Chapters (2,3 and 4), 8.1 to 8.3)
15 Hours

UNIT – III
Decision Making and Expert Systems:
Single person, Multi person, Multi criteria and Multi stage decision making, Expert system features, architecture and applications
(Text Book-2: Chapter s (1, 2 and 3))
9 Hours
Course Outcomes:
At the end of the course the student will be able to:
1. **Acquire** Knowledge about different constitutes of Soft Computing making use of diagrams and its applications
2. **Illustrate** Genetic Algorithms (GA) – Conceptual GA algorithm, Reproduction operators Mutation and Cross over, Applications of GA. Utilize learning approaches and agents
3. **Outline** the neural networks basics, network architectures, back propagation algorithm and applications
4. **Overview** of Fuzzy logic concepts, Membership Functions, Fuzzy Rules and Describe Fuzzy Models, Fuzzy Reasoning and Fuzzy Inference Systems
5. **Explain** Single person, Multi person, Multi criteria and Multi stage decision making. Acquire knowledge on Expert system features, architecture and applications

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Table-1: Mapping of COs to PI, POs and BTL
TEXTBOOKS:

REFERENCE BOOKS:

E-Books / Online Resources:

MOOC:
1. https://onlinecourses.nptel.ac.in/noc18_cs13/course
2. www.soft-computing.de/link.html
3. nptel.ac.in/courses/106105173/

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